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Technical Association Meets At Seattle

Splendid Program and Unusual Recreational Features Attract Over 500 Members and Guests To Fall Convention On the Pacific Coast — Committee Members Given Great Credit For Fine Meeting.

SEATTLE, Wash., August 26, 1940—For the second time the Technical Association of the Pulp and Paper Industry held its national fall convention in the far west. In 1934 the meeting was at Portland, Ore., and this year on August 20-23 about 500 members met at Seattle with headquarters at the Olympic Hotel. As in 1934 the Pacific hosts showed limitless hospitality. By giving the eastern members a distinctive colored badge it was made possible to note who were guests and hosts. The guests could not ask for more friendly helpfulness.

Able Local Committee

Originality and thoroughness marked the efforts of the convention committee under the aggressive leadership of G. S. Brazeau of the Everett, Wash., mill of the Weyerhaeuser Timber Company. Arrangements, always a difficult job was handled efficiently by Berk A. Bannon of the Western Gear Works. Helping him was H. U. Tarter of the University of Washington. M. B. Houston of Rayonier, Inc., carefully handled the finances, assisted by Fred Shaneman of the Pennsylvania Salt Manufacturing Company. W. R. Barber had the important job of obtaining the technical papers and is entitled to real congratulations on his accomplishment. Registration, a most ornary job at best was handled skillfully by Earl Thompson of the Dow Chemical Company. Leo S. Burdon of the Soundview Pulp Company got the members safely through his woodlands. The complicated details of organizing the special train were taken care of by Bill Geiger of Weyerhaeuser together with his old standby F. G. Scott of the Northern Pacific Railroad. H. A. (Gob) Des Marais of the General Dyestuff Company and Al Quin of the Stebbins Engineering and Mfg. Co., met the train at Livingston, Montana and saw that everyone aboard enjoyed themselves. The Ladies Program was the pleasant job of Ray Smythe of Portland, Ore., who was rated 100 per cent by the ladies for doing a swell job. Jim Brinkley took care of the entertainment in a way that will assure him of being called on again and Larry Smith of the Pacific Pulp and Paper Industry used publicity methods that were successful in getting a large attendance.

As in 1934 there was a TAPPI Special to take the eastern tenderfeet from Chicago, through the Indian country to Seattle. This fine air conditioned Northern Pacific train was the ideal means of transportation through the August temperatures of the Dakotas and the Mountain states. At Mandan, N. D., an interesting Indian ceremonial was featured and at Livingston, Montana, the members were shown a sample of an old western roundup, demonstrated by the local ranch hands who knew their lariats and steers. Places made memorable in 1934 were revisited and several visited the Yellowstone Park. Marvin Jones of the Michigan Carton Company, showed his skill as a trout fisherman and Roger Egan of Bulkley, Dunton & Co., showed the power of mind over matter by subduing a vicious broncho (Kalamazoo papers please copy). The train schedule was changed to permit the unusual opportunity of a daylight trip through the Cascades in Western Washington. At Livingston all TAPPI men and women wore ten gallon felt hats and arrived in Seattle bedecked in the same manner where they were heartily received by a large Western representation.

Serious Technical Program

Two innovations marked this fine meeting. It was underwritten entirely by those who attended and the West Coast mills. There were no exhibits or advertising space sold to supply companies who, instead, were invited to send their leading technical representatives to participate in and enjoy the meeting as co-workers with the millmen. The other feature was the extra emphasis placed on the importance of the technical papers which were carefully selected and ably presented by well informed men.

The Tuesday morning session was opened with an interesting color movie "Magic Fibers" produced by the Pacific Northwest Pulp and Timber Industries. This showed various phases of lumber operation. N. W. Coster, Chairman of the Pacific TAPPI Section presided and introduced Lee Paul Sieg, president of the University of Washington, in whose Bagley Hall all technical metings were held. Dr. Sieg welcomed those present and described how the University is endeavoring to integrate its activities with the growing technical, economic and cultural needs of the

State. He pointed out the program underway in the study of lignin to utilize this tremendous and important waste product of pulp manufacture.

The morning session under the guidance of B. L. Groudal, professor of forest products of the University of Washington, was devoted to a symposium on Pacific Northwest Forest Resources.

W. H. Price, forester of the Weyerhaeuser Timber Company, talked on Using the Forest Crop. He pointed out that the first sawmill began operation at Vancouver, Wash., in 1823 to cut Douglas fir. Today about 4000 important products are made of wood. Commenting on the Morrill Act wherein land grants were made to start colleges he showed how much forestry has done for educational opportunities in the United States. The timber using industries rank first in the Northwest, accounting for the occupation of 60 per cent of the workers and the support of one third of the Northwest population. He appealed for a lower tax rate for timber, especially during the growing stage. About 70 per cent of the wood used is Douglas fir, 10 per cent cedar, both used for lumber and 20 per cent Western hemlock used for wood pulp. Research men were urged to find new uses for wood.

Warren Tilton, forester of the West Coast Lumbermans Association discussed the Interdependence of the West Coast Tree Species. The statistics given showed the formidable size of the industry. Lumber companies today are cooperating in supplying each other with woods to meet their respective requirements. A company specializing in cedar sells its hemlock to pulp producers and its Douglas fir to lumber companies specializing in its use. There are 14 million acres of timberland standing as a storehouse to meet the future needs of the country. One third of the standing timber of the United States is in the northwest and is capable of producing 600 million tons of pulp or 8-9 billion board feet per year.

Axel J. Brandstrom of the Crown Zellerbach Corporation outlined the economy problem of Forest Management in the Douglas Fir Region. The Pacific Northwest covers 35 million acres, one third of which supports virgin timber, one-third second growth timber and one third farm, townsite and mountains.

W. H. SWANSON
President

R. G. MACDONALD
Secretary

Logging costs are high and need protection from competition from foreign countries and low labor cost regions. The problem of forest management is complex since so many elements contribute to high logging costs.

All the speakers attempted to answer the criticism of apparent wasteful logging practices and showed that real waste is relatively small. With the tremendous abundance of wood it is of greater importance to all concerned to select only the best trees, there being far more mature trees available than the country can use and the apparent destruction is not real since room is made for the growth of healthy trees for future needs.

J. L. Pearson, an independent truck logger pointed out that there is a need of reform in the policy of selling wood. It should be sold on a cubic foot rather than a board foot basis and graded for quality.

Following the symposium the meeting adjourned for luncheon at the University Commons and again met to discuss mill problems in the afternoon.

H. K. Benson of the University of Washington presided at the afternoon session in Bagley Hall.

R. A. HAYWARD
Vice President

The first speaker was W. L. Beuschlin of the University of Washington who with Milton A. Porter discussed the effect of combined sulphur dioxide upon the liquid film absorption coefficient. The paper showed the effect of dissolved calcium bisulphite on the resistance of the liquid film to the transfer of sulphur dioxide across a gas-liquid interface.

Arthur Walton also of the University describes his work on the pulping of Douglas fir by nitric acid. The yield was found to be low in comparison with the yields from hemlock and spruce but the quality of the pulp is good. Through the recovery of oxalic, formic and acetic acids and their reuse in multiple stages this method of cooking involves no waste disposal problem. It has been carried out only in the laboratory stage.

L. C. Haffner a consulting engineer and Kenneth A. Kobe of the University outlined a modified sodium sulphide process for pulping Douglas fir, the greatest wood supply available today and for which no satisfactory pulping process exists for the production of commercial bleached pulp. By careful control of the pH of the liquor (a modified sodium sulphite) a quality pulp can be produced on a small scale.

Harry F. Lewis and Kenneth D. Day of the Institute of Paper Chemistry, presented an analysis of the chemical composition of balsam bark in an effort to find uses for it other than for fuel.

W. F. Gillespie of the Gaylord Container Company, Bogalusa, La., showed how fused soda ash-sulphur can be used as a substitute cake in the kraft recovery process.

S. D. Wells of the Institute of Paper Chemistry, outlined the applications and limitations of the use of the rod mill in paper mills. Beating with rods has been found advantageous in the following operations: pulping of semi-cooked chips for corrugated paper and test liners; pulping kraft, sulphite and groundwood screenings; pulping of rotary stock in strawboard manufacture with substantial power savings; utilization of rag waste and praparation of rags for roofing felt; preparation of wood, straw, cornstalks and bagasse for wall board manufacture and the liberation of ink from waste papers.

A dinner dance was held in the Spanish Ball Room

G. S. Brazeau
General Chairman

W. R. Barber
Chairman Technical Program Committee

and was featured by the annual presentation of the Shibley award for the best paper presented during the year in the Pacific Section by one of the young millmen. This presentation was made by Ralph Hayward, president of the Kalamazoo Vegetable Parchment Company and vice president of the Technical Association to Cecil Triplett of the Hawley Pulp and Paper Company for his paper on "A Routine Test for Organic Matter in Sulphite Liquor." It was originally planned to have the presentation made by W. H. Swanson, president of TAPPI who performed this ceremony last year. Mr. Swanson was unfortunately unable to attend the Seattle meeting.

Wednesday Session

George H. McGregor of the Weyerhaeuser Timber Company presided at the Wednesday morning technical session.

F. E. Brauns of the Institute of Paper Chemistry discussed the recent advances in the chemistry of lignin. The sensitiveness of lignin toward oxidation and other reactions makes the solution of this problem difficult. When the problem is solved we may have the basis for an industry far greater than that of coal tar utilization.

E. E. Harris of the Forest Products Laboratory described the hydrogenation of lignin in dioxane and also in aqueous suspensions in the presence of appropriate catalysts. Propylcyclohexane compounds are produced.

J. L. McCarthy of McGill University discussed recent developments relating to the structure and formation of lignin.

A. J. Bailey of the University of Washington described the chemistry of butanol lignin.

L. V. Forman of the Institute of Paper Chemistry showed the action of ultra violet light on lignin. This research will lead to improved knowledge of the reasons why papers fade and possibly how this can be prevented.

R. L. Glading of the West Virginia Pulp and Paper Company discussed the ultra violet absorption spectrum of lignin and related compounds.

H. K. Benson and Irwin A. Pearl of the University of Washington talked on the preparation of lig-

nin from calcium lignosulphonate by treatment with sodium hydroxide.

Wednesday Afternoon Session

Following a luncheon recess the following papers were presented under the chairmanship of N. W. Coster of the Soundview Pulp Company.

John H. Graff, M. A. Schlosser and Edna K. Nihlen of the Institute of Paper Chemistry showed interesting slides of pulp fiber cross sections. These showed the degree of cooking and purification of the pulps. A thorough understanding of cross section microphotographs of fibers should give the trained observer much valuable data for a better understanding of beating, dyeing, retention of fillers and felting characteristics of pulps.

E. R. Laughlin of E. I. du Pont de Nemours, Wilmington, Del., discussed the influence of dyestuffs on the opacity of papers.

W. R. Willets, R. T. Burgham and L. H. Ericksen the Titanium Pigment Company described the effect of subliners on the brightness of paperboard. It is shown that the characteristics of the top liner is more important than that of the subliner. Proper use of titanium dioxide in the top liner makes it possible to mask any base and to secure good ultimate color and brightness.

L. T. Jenness and J. G. L. Caulfield of the University of Maine presented (by title) a paper on the heat transfer characteristics of an indirect heated experimental digester.

A meeting held simultaneously with the one just described was presided over by C. C. Heritage of the Wood Conversion Company, Cloquet, Minn.

R. E. Chase of Tacoma, Wash., discussed air filtration in the pulp and paper industry.

W. G. MacNaughton of the News Print Service Bureau, New York, N. Y., presented (by title) a paper on the flow box and slice on newsprint machines. This paper was discussed in a written communication from J. B. Gough of the Mead Corporation, Chillicothe, Ohio.

C. A. Hulsart of the Babcock & Wilcox Company, New York, N. Y., described bark burning furnaces and gave analyses of wood refuse and showed how efficient combustion can be effected commercially.

Nels G. Johnson of Simons Worden White Company, Dayton, Ohio, discussed the characteristics of suitable chipper knives and showed how they should be ground.

J. F. White and G. P. Vincent of the Mathieson Alkali Works, New York, N. Y., gave a comparison between chlorite and hypochlorite as a bleaching agent for wood pulp. By use of sodium chlorite as a supplement to hypochlorite a wood pulp can be bleached to a high brightness without loss of fiber strength. No complicated control is necessary.

J. Stanley Martin and M. W. Bray of the Forest Products Laboratory, Madison, Wis., presented (by title) a paper or alkaline pulping of western white pine. A pulp of high tensile strength is obtained.

G. J. Hajny and G. J. Ritter of the Forest Products Laboratory described the conversion of holocellulose to pulps suitable for high grade papers. The pulp produced had properties commensurate with sulphite pulps.

In the afternoon the following papers were presented:

PICTURE TAKEN AT TAPPI MEETING AT UNIVERSITY OF WASHINGTON, DR. BENSON SPEAKING.

PICTURE TAKEN AT TAPPI DINNER-DANCE AT HOTEL OLYMPIC, SEATTLE, WASH.

B. W. Rowland of the Institute commented on the use of starch in papermaking. Particular emphasis was given to wet end application.

Alan P. Adrian and John Graff of the Institute gave a comparative evaluation of the different methods of dirt count of pulp.

William Rabak of the United States Frozen Pack Laboratory presented a report on his study of the relative water vapor resistance of paper and other materials for use in packaging and wrapping frozen fruits and vegetables.

Philip Nolan of the Institute showed some applications of spectrographic analysis to pulp and paper problems.

O. T. Defieux of the Crown Zellerbach Corporation gave some of his reactions to the course in vocational education at the Camas mill. Mr. Defieux is steam plant superintendent at this mill.

Group Technical Dinners

A new fall meeting feature was the holding of a number of dinners on a single evening for groups interested in special phases of pulp and paper manufacture. Following were the major subjects discussed by the separate groups and the leader of the discussions that followed after dinners:—

Norman Kelly, manager of the Longview Mill of the Weyerhaeuser Timber Company led the discussion of acid pulping and bleaching.

Alkaline pulping and bleaching were discussed by a group headed by C. E. Curran of the Forest Products Laboratory, Madison, Wis.

Henry W. Beecher of Seattle led the groups that discussed power.

Applied hydraulics was discussed by R. V. Bingham, president of the Bingham Pulp Company and his group.

R. S. Wertheimer, manager of the Longview Fibre Company, led a discussion of paper machine problems.

The papers mentioned in this report will be published in the PAPER TRADE JOURNAL.

The Woods Trip

No meeting of pulp and paper men in the Pacific Northwest would be complete without a visit to woods operations. A visit was therefore made to the Soundview Pulp Company's holding at Nooksak, Wash., and Lake Grandy, on Thursday, August 22. Big timber logging operations were shown in detail and a real lumberjack luncheon was served at Camp 18.

Sporting Events

The spirit of the real fisherman was demonstrated by the large number who were awakened at 4:00 A.M., Friday, August 23, to go to Everett, Wash., to compete in the salmon derby. Prizes were given for the catching of fish of various descriptions. A golf tournament was held in the afternoon.

The Banquet

The convention was closed on Friday evening, August 23, with a banquet at which J. D. Zellerbach, president of the Crown Zellerbach Corporation, presided as toastmaster. The speaker was Charles Copeland Smith of Seattle, who represented the National Association of Manufacturers.

Ladies Program

An excellent program was arranged for the ladies who attended the convention.

On August 20 Florenz Clark, internationally known artist, exhibited a number of her paintings in the auditorium of Frederick & Nelson's store and gave a talk on the background of commercial art and illustration. This was followed by a fall fashion show and in the evening by a dinner dance in the Olympic Hotel.

The ladies' golf tournament was held on August 21 at the Broadmoor Country Club and in the afternoon a sightseeing trip, garden tour and tea was conducted. In the evening a dinner was held at which Ray Smythe discussed the astrological future.

On August 22 there was an all day boat trip to Victoria, B. C. A sightseeing trip through Victoria and Butchart's gardens followed.

A luncheon at the Olympic Hotel on Friday, August 23, featured a talk by Mrs. A. G. Natwick on her experiences as a delegate to the Republican National Convention at Philadelphia. This was followed by a bridge party in the Olympic Bowl and in the evening by a reception, banquet and dance.

Those Who Attended the Convention

Official Registration of the Technical Association of the Pulp and Paper Industry

List of Registrations of the Technical Association of the Pulp & Paper Industry

A

O. C. Abbott, the Bristol Co., Seattle
Mr. and Mrs. C. E. Ackley, Hawley Pulp & Paper Co., Oregon City
Mr. and Mrs. H. J. Adrian, Consolidated Water Power and Paper Co., Stevens Point, Wis.
Tore Ahlen, Svenska Flatfabriken, Stockholm
Olavi Aho, Rainier, Inc., Grays Harbor
Leslie Anderson, Weyerhaeuser Timber Co., Longview, Wash.
Mrs. Joseph Ashby, New Westminster, B. C.
John Ashby, Westminster Paper Co., New Westminster, B. C.
Jerry Alcorn, Weyerhaeuser Timber Co., Everett
Arn S. Allen, Jr., Seattle Hardware Co., Seattle
Fred Alsop, Van Waters & Rogers, Portland, Ore.
Edward Anderson, Champion Paper & Fibre Co., Hamilton, Ohio
Evald Anderson, Western Precipitation Co., Los Angeles
Niles M. Anderson, St. Regis Kraft Co., Tacoma
Mr. and Mrs. L. C. Anderson, Ontario Paper Co., Thorold, Ont.
Fred R. Armbruster, The Dow Chemical Co., Seattle
Carl Arrington, Weyerhaeuser Timber Co., Everett

B

Mr. and Mrs. A. E. Bachmann, Missisquoi Corp., Sheldon Springs, Vt.
C. L. Bachelder, Hercule's Powder Co., Kalamazoo, Mich.
Milton R. Bailey, Bulkley, Dunton Paper Co., New York
L. C. Baltzelle, Pacific Indemnity Co., Seattle
A. Bankus, Crown Zellerbach Corp., Portland
Berk Bannan, Western Gear Works, Seattle
Mr. and Mrs. T. J. Bannon, Western Gear Works, Seattle
W. R. Barber, Crown Zellerbach Corp., Camas, Wash.
John Bardsley, Powell River Co., Ltd., Powell River
Mr. and Mrs. W. L. Barker, Improved Paper Mach. Corp., Nashau, N. H.
E. J. Bartells, E. J. Bartells Co., Seattle
D. F. Bartholet, Fairbanks, Morse & Co., Seattle
Charles L. Bauer, The Bauer Bros. Co., Springfield, Ohio
Mr. and Mrs. Sid. Baunsgard, Socony Vacuum Oil, Tacoma
R. B. Beal, Flox Co., Minneapolis
H. W. Beecher, Consulting Engineer, Seattle
Geo. Beise, Weyhaeuser Timber Co., Longview, Wash.
Mr. and Mrs. H. K. Benson, U. of W., Seattle
W. L. Beuschlein, U. of W., Seattle
Mr. and Mrs. A. L. Bibbins, Electric Steel Foundry, Seattle
L. K. Bickell, B. C. Pulp & Paper Co., Woodfibre, B. C.
Paul Billington, Weyerhaeuser, Longview, Wash.
Myron Black, Inland Empire Paper Co., Millwood, Wash.
Chas. H. Black, Seattle Hardware Co., Seattle
Ross Black, Powell River Co., Ltd., Powell River
G. Park Boian, American Rolling Mill Co., Portland
Bernard Bornstein, Norton Co., Worcester, Mass.
A. E. Boss, Columbia Alkali Corp., Barberton, Ohio
Harry S. Bowen, Puget Sound Sheet Metal Works, Seattle
F. W. Brainerd, Scott Paper Co., Chester, Pa.
Dr. F. E. Brauns, Institute of Paper Chemistry, Appleton, Wis.
Prof. Paul Bray, U. of Maine, Orono, Maine
G. W. Brown, Weyerhaeuser Timber Co., New York
G. J. Brabender, Marathon Paper Mills, Rothschild, Wis.
G. S. Brazeau, Weyerhaeuser Timber Co., Everett
W. E. Breitenbach, Rayonier, Inc., Hoquiam, Wash.
Martin Breuer, E. I. DuPont de Nemours & Co.
J. F. Brinkley, James Brinkley Co., Seattle
N. M. Brisbois, Fibreboard Products, Inc., Stockton, Cal.
D. Brittain, Mead Sales, Chicago, Ill.
E. B. Brookbank, Mead Corp., Chillicothe, Ohio
R. S. Buckley, Fernstrom Paper Mills, Inc., Pomona, Cal.
R. E. Bundy, Fibreboard Products, Inc., Port Angeles, Wash.
L. S. Burdon, Soundview Pulp Co., Everett, Wash.
E. C. Burwell, Dycalite, Los Angeles, Cal.
H. R. Bushley, Elliott Co., Seattle

C

Claude W. Callaghan, Flox Co., Tacoma, Wash.
Olin W. Callighan, Edgar Bros., Clay, Kalamazoo, Mich.
R. S. Carey, National Analine & Chemical Co., Portland, Ore.
G. N. Carleton, Detroit Sulphite Paper Co., Detroit, Mich.
John M. Carlson, Soundview Pulp Co., Everett, Wash.
O. S. Cauvel, Washington Pulp & Paper Co., Port Angeles
J. E. Cater, Hawley Pulp & Paper Co.
C. H. Champion, R. T. Vanderbilt Co., New York
Dan E. Charles, Pulp & Paper Mills Supply
G. W. Charters, Crown Zellerbach Corp., Camas, Wash.
Mr. and Mrs. R. E. Chase, R. E. Chase & Co., Tacoma, Wash.
R. E. Chase, Jr., R. E. Chase & Co., Portland, Ore.
Mr. and Mrs. C. R. Clark, Merrick Scale Mfg. Co., Passaic, N. J.
Carl L. Clark, Nash Engineering Co., New York.
Mr. and Mrs. James d'A. Clark, Institute of Paper Chemistry, Appleton, Wis.
Mr. and Mrs. William W. Clark, Longview, Fibre Co.
R. W. Clark, Northern Pacific R.R., St. Paul
Walter Clifford, Penick & Ford Ltd., Cedar Rapids
R. B. Colby, Coos Bay Co., Empire, Ore.
Sidney M. Collier, Puget Sound P. & T., Bellingham, Wash.
N. W. Coster, Soundview Pulp Co., Everett
J. V. B. Cox, Hercules Powder Co., Portland
J. A. Cunningham, Simonds Saw & Steel, Tacoma
C. E. Curran, Forest Prods. Lab., Madison, Wis.

D

H. N. Danielsen, Simonds Saw & Steel, Portland
C. W. Davies, Standard Oil of Cal.
Roy L. Davis, Detroit Sulphite Pulp & Paper Co., Detroit, Mich.
O. T. Defieux, Crown Zellerbach, Camas, Wash.
C. H. Deleventi, Crown Zellerbach, Camas, Wash.
Miss Ruth Denison, Beloit Iron Works, Beloit, Wisc.
U. S. Denison, Beloit Iron Works, Beloit, Wisc.
H. A. Des Marais, Genl. Dyestuff Corp., San Francisco
T. E. Dial, Socony-Vacuum Oil, New York
G. K. Dickerman, Consolidated Water Power & Paper Co., Wisconsin Rapids
George Dickson, Stetson-Ross Machine Co.
R. A. Diehm, Rohn & Haas Co., Appleton, Wisc.
Ralph E. Drane, St. Helens Pulp & Paper Co., St. Helens, Ore.
Arthur C. Dreshfield, Hercules Powder Co., Wilmington
E. G. Drew, Drew & Hoffman, Portland
Pierre Drewsen, Hinde & Dauch Paper Co., Sandusky
J. R. Dufford, Paterson Parchment Paper Co., Bristol, Pa.
Mr. and Mrs. A. C. Duncan, Hercules Powder Co., Portland, Ore.
George C. Dunn, Dunn Sulphite Co., Pt. Huron, Mich.

E

R. J. Egan, Bulkley Dunton Paper, New York
H. O. Ehrisman, Foxboro Co., Foxboro, Mass.
E. Ekholm, Puget Sound Pulp & Timber Co., Bellingham
Ivar Ekholm, National Analine, New York
Sigge Ekman, Rhinelander Paper Co., Rhinelander, Wis.
E. Ericsson, Puget Sound Pulp & Timber Co., Bellingham
Art Erickson, Weyerhaeuser Timber Co., Longview, Wash.
D. L. Erickson, Weyerhaeuser Timber Co., Longview, Wash.
Mr. and Mrs. Clayton Ewing, Falls Pulp & Paper Co., Oconto Falls
L. R. Ewing, Longview Fibre Co., Longview, Wash.

F

Carl Fahlstrom, Longview Fibre Co., Longview, Wash.
Frank Fieweger, Acer & Co., Chicago
L. E. Fitzgerald, Hercules Powder Co., Kalamazoo, Mich.
H. T. Fretz, Rayonier, Inc., Port Angeles, Wash.
Francis Flinn, Crown Williamette Paper, Camas, Wash.
Mr. and Mrs. Fortier, Everett, Wash.
Mr. and Mrs. Frank Frothingham, Bird Machine Co., Chicago

G

Irving R. Gard, Merrick Scale Mfg. Co.
John H. Graff, Insti. of Paper Chem., Appleton, Wis.
Wm. A. Geiger, Weyerhaeuser Timber Co., Chicago
O. P. Gephart, Miamisburg Paper Co., Miamisburg, Ohio
H. B. Gerber, Williams Gray Co., Chicago
H. Gevers, Longview, Wash.
W. R. Gibson, Northwest Filter Co.
F. X. Gilg, Babcock & Wilcox Co., New York
W. F. Gillespie, Gaylord Container Corp., Bogalusa, La.
George A. Gladding, Soundview Pulp Co., Everett
Mr. and Mrs. Les T. Graham, Link-Belt Co., Seattle
L. L. Griffiths, Williams-Gray Co., Kalamazoo, Mich.
George G. Guild, Huntington Rubber Mills, Inc.
Mr. and Mrs. A. Gustin, Rayonier, Inc., Hoquiam, Wash.
E. J. Gellenbeck, Keystone Lubricating, Tacoma

H

H. W. Hall, Dicalite Company
Mr. and Mrs. Kenneth B. Hall, Improved Paper Mach., Portland
R. N. Hammond, Weyerhaeuser Timber Co., Longview, Wash.
D. V. Hamilton, Weyerhaeuser Timber Co., Everett
A. B. Hansen, Northern Pacific Mills, Green Bay, Wis.
John A. Hanson, Badger Paper Mill Co., Peshtigo, Wis.
M. Hartnagel, Fibreboard Prods., Pt. Angeles, Wash.
Howard Harrison, Crystal Tissue Co., Middletown, Ohio

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R. S. Hatch, Weyerhaeuser Timber Co., Longview, Wash.
Bert Hatton, Johns-Manville
A. D. Hawley, Pacific Coast Supply Co.
Jack Hayward, Kalamazoo, Mich.
Hauff Harald, Weyerhaeuser Timber Co., Longview, Wash.
R. A. Hayward, Kalamazoo Veg. Parchment Co., Kalamazoo, Mich.
Ed. Heise, Wallace & Tiernan, Seattle, Wash.
J. W. Hemphill, Johns-Manville, New York
C. C. Heritage, Wood Conversion Co., Cloquet, Minn.
Raymond P. Hill, Pulp Bleach Co., Wausau, Wis.
Dr. and Mrs. W. Hirschkind, The Dow Chemical Co., Pittsburg, Cal.
Walter S. Hodges, Paper Machine Clothing & Rolls, Portland, Ore.
Mr. and Mrs. Frederick J. Hoffman, Hydraulic Supply Mfg. Co., Seattle
John Hoffman, Drew & Hoffman, Portland.
W. F. Hoffman, Northwest Paper Co., Cloquet, Minn.
Holcomb, Edison Storage Battery Supply
J. L. Hoolihan, Pt. Huron Sulphite & Paper Co., Port Huron, Mich.
A. H. Hooker, Jr., Hooker Electrochemical, Tacoma
George Houghton, U. S. Rubber Co., Seattle
H. H. Houtz, Crown Zellerbach Corp., Camas, Wash.
H. I. Hotz, Central Paper Co., Muskegon, Mich.
O. L. Hudrlik, Flox Co., Portland
C. A. Hulsart, Babcock & Wilcox, New York
Mr. and Mrs. Houston, Rayonier, Inc., Seattle
W. F. Hynes, General Electric Co., Portland

I

E. P. Ingalls, S. D. Warren Co., Cumberland Mills, Me.

J

Jack Johnson, Appleton Woolen Mills, Appleton, Wis.
Nels G. Johnson, Simonds Worden White Co., Dayton, Ohio
R. B. Johns, Freeport Sulphur Co., New York
M. C. Jones, Michigan Carton, Battle Creek
Herman Jorgensen, Weyerhaeuser Timber Co.

K

W. N. Kelly, Weyerhaeuser Timber Co., Longview, Wash.
B. L. Kerns, Westinghouse Electric & Manufacturing Co., Seattle
F. G. Keuss, St. Regis Kraft Co., Tacoma, Wash.
Lawrence Killam, B. C. Paulp & Paper, Vancouver
W. W. King, Oliver United Filters, Oakland, Cal.
J. O.Kjome, Scientific Supplies Co., Seattle
F. P. Klund, Hammermill Paper Co., Erie, Pa.
Leonard P. Koepp, United States Rubber Co., Seattle
Harry Kolb, Hercules Powder Co., San Francisco

L

F. J. Lammers, Internatl. Filter Co., Chicago
Miss Edith Lash, Longview, Wash.
Dr. E. R. Laughlin, E. I. duPont de Nemours, Wilmington, Del.
Mr. and Mrs. E. A. Lauring, Insulite Co., International Falls, Minn.
Ralph M. Leighton, Stowe & Woodward, Newton Upper Falls, Mass.
Foss B. Lewis, Simonds Saw & Steel, Portland
Dean Harry F. Lewis, Insti. of Paper Chem., Appleton, Wis.
J. G. Long, Fir Tex Insul. Bd., St. Helens, Ore.
Frank J. Lovegren, Inland Empire, Millwood, Wash.
H. G. Lockerbie, U. S. Rubber, Portland
A. H. Lundberg, Seattle, Wash.

M

D. K. MacBain, Weyerhaeuser Lumber Co., Longview
L. S. McCurdy, Crown Zellerbach Corp., Pt. Townsend, Wash.
C. R. McCully, Weyerhaeuser Timber, Longview
Mr. and Mrs. J. J. McDonald, Brown Co., New York
R. G. Macdonald, TAPPI, New York City
George H. McGregor, Weyerhaeuser Timber Co., Longview
P. J. McGuire, Oliver United Filters, Oakland
A. McLintoch, Texas Gulf Sulphur, New York
L. McMaster, Asten-Hill Mfg. Co., Philadelphia
J. J. McNair, Weyerhaeuser Timber Co., Longview, Wash.
R. B. Martin, Wallace & Tiernan, Newark, N. J.
D. B. Mason, Freeport Sulphur Co., New York
Taber H. Mahler, A. O. Smith Corp., Los Angeles
R. V. Maier, Genl. Electrical Co., Portland
N. L. Malcove, Northern Paper Mills, Green Bay, Wis.
R. W. Martig, Brown Instrument Co., Portland
Mr. and Mrs. C. J. McAllister, Simonds Warden White Co., Portland, Ore.
Dr. J. L. McCarthy, McGill Univ. & Fraser Co., Montreal
Dan McGillicuddy, Jr., Rayonier, Inc., Hoquiam, Wash.
A. M. Mears, Pacific Coast Supply, Portland
J. S. Mears, Crown Zellerbach Corp., Camas, Wash.
Ned Menzies, W. S. Tyler Co., Cleveland
W. C. Marshall, Pacific Coast Supply, Portland
Peter J. Massey, Combined Locks Co., Combined Locks, Wis.
Norman Miller, Westinghouse Electric & Manufacturing, Portland
K. M. Milligan, Northwest Lead Co., Seattle
T. E. Moffitt, Hooker Electrochemical, Tacoma
T. H. Moran, Weyerhaeuser Timber Co., Longview, Wash.
C. W. Morden, Morden Machines Co., Portland
Douglas Morris, Jas. Brinkley & Co., Seattle
Fred Mullen, Taylorville, Ill.
Nip Mullen, Hopper Paper Co., Taylorville, Ill.
C. T. Mulledy, Rayonier, Inc., Port Angeles
W. A. Munro, Flambeau Paper Co., Park Falls
W. C. Minnaw, Calif.-Oregon Paper Co., Medford

N

L. F. Newton, Electro Associates, Portland
F. E. Nicholson, Stetson-Ross Machine Co., Seattle
Mr. and Mrs. George H. Norris, Hydraulic Supply Mfg. Co., Seattle.

O

Max Oberdorfer, St. Helens Pulp & Paper. St. Helens
J. J. O'Brien, The Paper Mill, Boston, Mass.
F. A. Olmsted, Crown Zellerbach Corp., Camas, Wash.
A. Orup, Soundview Pulp Co., Everett
H. E. Ostenson, Crown Zellerback, Camas, Wash.

P

G. V. Palmrose, Weyerhaeuser Timber Co., Longview
Mr. and Mrs. C. D. Parker, The Fafnir Bearing Co., Seattle
T. A. Pascoe, Nekoosa-Edwards Paper, Pt. Edwards
Frederic H. Peabody, Union Screen Plate Co., Fitchburg, Mass.
Frederic M. Pope, Wilson & George Meyer, Seattle
N. L. Peck, Columbia Steel Co., Portland
J. W. Peckham, Bristol Co., San Francisco
Morris Peterson, Weyerhaeuser Timber Co., Longview, Wash.
James Petrie, Pacific Mills, Ltd., Ocean Falls, B. C.
R. T. Petrie, Black-Clawson Co., Portland
M. W. Phelps, Solvay Process, Syracuse
William Pittam, Weyerhaeuser Timber, Longview, Wash.
W. T. Pritchard, Stetson-Ross Machine Co., Seattle

Q

A. S. Quinn, Stebbins Eng. Construc., Seattle

R

Carl Ramstad, Soundview Pulp Co., Everett
H. T. Randall, Champion Paper & Ribre Co., Pasadena, Texas
Ralph Reid, Spaulding Pulp & Paper, Newberg
Lewis S. Reid, Metropolitan Life Ins. Co., New York
D. F. Reynolds, Fairbanks, Morse & Co., Seattle
G. H. Rice, Kalamazoo Veg. Parchment, Kalamazoo
E. D. Rich, Oregon Pulp & Paper Co., Salem
H. H. Ringmond, Electric Steel Fdry., Portland
George J. Ritter, Forest Products Lab., Madison, Wis.
C. W. Rivise, Caesar & Rivise, Philadelphia
T. C. Roberts, Beloit Iron Wks., Beloit, Wis.
E. M. Root, Dilts Machine Wks., Fulton, N. Y.
B. W. Rowland, Insti. of Paper Chem., Appleton
J. P. Rubush, Swenson Evaporator Co., Harvey
J. D. Rue, Hooker Electrochemical Co., Niagara Falls
H. T. Ruff, Mead Corp., Chillicothe, Ohio

S

S. A. Salmonson, Soundview Pulp Co., Everett
W. A. Salmonson, Simonds Warden White Co., Portland
N. H. Sandberg, Waldorf Paper Prods. Co., St. Paul
J. Scheuermann, Cameron Machine Co., Chicago
M. A. Schiel, A. O. Smith Corp., Milwaukee, Wis.
F. B. Schilling, Nichols Eng. & Research, New York
A. J. Schmitz, Allis Chalmers Mfg. Co., Seattle
Forest G. Scott, Northern Pacific R.R., Chicago
Harlan Scott, Pacific Pulp & Paper, Seattle
Chas. M. Server, Philadelphia Felt Co.
Fred Shaneman, Pennsylvania Salt Mfg., Tacoma
Brian Shera, Pennsylvania Salt Mfg., Tacoma
D. L. Shirley, Link-Belt Co., Portland, Ore.
Joseph Shrawder, Krebs Pigment & Color Corp., Wilmington, Del.
Mr. and Mrs. C. Sholdebrand, Hawley Pulp & Paper, Oregon City
R. S. Sinclair, Sinclair Co., Holyoke, Mass.
F. T. E. Sisson, Racquette River Paper Co., Potsdam
C. B. Smith, Huron Milling Co., Kalamazoo
C. V. Smith, St. Helens Pulp & Paper Co., St. Helens, Ore.
J. C. Smith, Std. Oil Co. of Calif., San Francisco
J. F. Smith, Dow Chemical Co., San Francisco
L. K. Smith, Pacific Pulp & Paper Industry
Ray Smythe, Rice, Barton & Fales, Portland
Harry and Harry M. Specht, Eastwood Neaby Corp., Bellville, N. J.
I. J. Stafford, Neenah Paper Co., Neenah, Wis.
L. C. Stevenson, Weyerhaeuser Timber Co., Longview
J. P. Strasser, Stein Mfg. Co., Chicago
J. B. Symonds, Sinclair Wire Co., Seattle
Frank Sumner, Sumner Iron Works, Everett

T

H. V. Tartar, University of Washington
A. Ward Tedrow, Hawley Pulp & Paper Co., Oregon City
Robert I. Thieme, Sound-View Pulp Co., Everett, Wash.
E. G. Thompson, Dow Chemical Co., Seattle
V. L. Tipka, Hawley Pulp & Paper Co., Oregon City
E. H. Tidland, Pacific Coast Supply Co., Portland, Ore.
T. W. Toovey, Pennsylvania Salt Mfg., Philadelphia
R. M. True, General Dyestuff Corp., Portland
James Turek, Jr., Stein Hall Mfg. Co., Portland

U

Howie Urquhart, Powell River Co., Ltd., Powell River

V

G. R. Vering, Weyerhaeuser Timber Co., Longview, Wash.
Earl Van Pool, Brown Co., San Francisco
Preston Varney, Weyerhaeuser Timber Co., Longview, Wash.
Mr. & Mrs. A. S. Viger, Rayonier, Inc., Shelton, Wash.
G. P. Vincent, Mathieson Alkali Works, New York
H. K. Vinton, *Paper Trade Journal*, New York and Chicago
H. A. Vernet, A. E. Staley Mfg. Co., Decatur, Ill.
Miss Betty Voss, Nekoosa-Edwards, Port Edwards, Wis.

W

Mr. and Mrs. R. D. Waddell, Crown-Willamette Paper Co., Lebanon, Ore.
H. F. Warren, R. E. Chase & Co., Seattle
L. H. Wear, Taylor Instrument, Seattle
E. A. Weber, Oregon Pulp & Paper Co., Salem, Ore.
C. E. Weinland, Johns-Manville, San Francisco
Fred V. Wellington, Western Gear Works, Seattle
Sidney D. Wells, Insti. of Paper Chem., Appleton, Wis.
H. R. Wemple, Texas Gulf Sulphur Co., New York
R. S. Wertheimer, Longview Fiber Co., Longview, Wash.
R. L. Wharton, Titanium Pigment Corp., Seattle
J. E. Whitefield, Brown Paper Mills, Monroe, La.
William R. Willets, Titanium Pigment Corp., New York
Clark Williams, Rayonier, Inc., Hoquiam
J. A. Wilcox, Longview Fibre Co., Longview, Wash.
Jack Wilcox, Electric Steel Fdry., Portland
Ralph A. Wilkins, Bird & Son, East Walpole, Mass.
R. B. Wolf, Weyerhaeuser Timber Co., Longview, Wash.
Ed. Wood, Weyerhaeuser Timber Co., Longview, Wash.
John Willy, American Reinforced Paper Co., Attleboro, Mass.
W. H. Williamson, Shuler & Benninghafer, Portland
G. O. Wilson, Dorr Co., Spokane
Lloyd F. Wray, Simonds Saw & Steel Co., Seattle

Y

H. W. Young, Paper Industry, Portland

Z

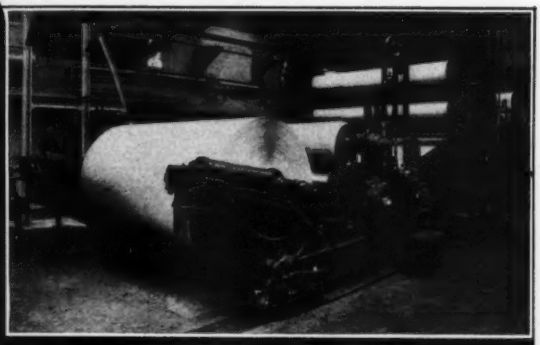
Erik Zimmerman, Chesapeake Corp., West Point, Va.

BELOIT

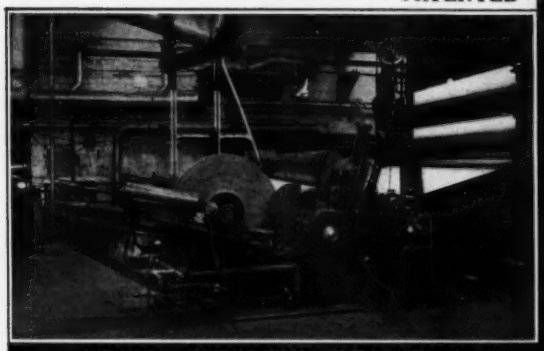
BOARD MACHINE

Reel

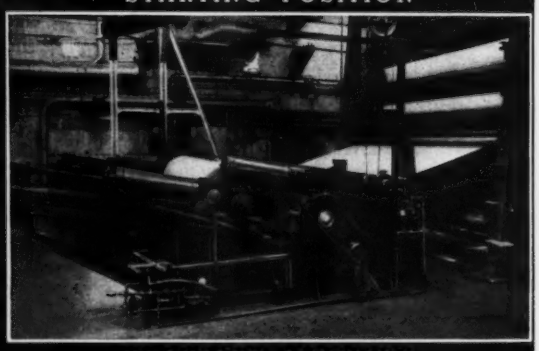
PATENTED



STARTING POSITION



FINAL WINDING POSITION



TRANSFER POSITION

DESIGNED FOR VERY HEAVY DUTY—TO WIND UP TO 78" DIAMETER ROLLS.

AIR PRESSURE, INDEPENDENTLY APPLIED TO FRONT AND BACK SIDES OF REEL SPOOL, MAINTAINS CORRECT WINDING CONDITION FOR GOOD ROLLS.

AIR PRESSURE CAN ALSO BE USED TO RELIEVE THE WEIGHT OF THE ROLL BEING WOUND.

NO BROKE WHEN CHANGING SPOOLS.

CAN BE INSTALLED ON PRESENT MACHINES.

THE BELOIT WAY IS THE MODERN WAY

BELOIT IRON WORKS PAPER MACH'Y BELOIT WIS

BELOIT IRON WORKS

BELOIT
WISCONSIN

Kimberly-Clark Wadding Mill Ready Soon

Construction of New Coarse Wadding Mill of Kimberly-Clark Corp. At Neenah, Wis., To Be Ready For Installation of Machinery Next Week—Consolidated Increases Hourly Wages—Other News.

[FROM OUR REGULAR CORRESPONDENT]

APPLETON, Wis., August 26, 1940—Construction of the Kimberly-Clark Corporation's new coarse wadding mill at Neenah, Wis., will be finished next week by the Siesel Construction Company of Milwaukee, Wis. It will then be turned over to the company by the contractors for the installation of machinery.

Features not found in the average manufacturing building have been incorporated, including air-conditioning, acoustical ceilings and glazed tile walls in the machinerooms. It also has 8,300 square feet of glass block windows. The overall size of the structure is 235 by 72 feet, and it is 70 feet high. Although the building is practically fireproof, a sprinkler system is being installed.

The new mill is adjacent to the company's Badger-Globe mill, and the two will be joined by a doorway now being constructed.

Riverside Awarded Safety Plaque

The Riverside Paper Corporation, Appleton, Wis., has been awarded an engraved plaque by the Employers Mutual Liability Insurance Company of Wausau, Wis., because of its outstanding safety record. In an entire year of operations developing 342,228 man-hours of work, the company had only one accident in which an employee lost time from work.

Consolidated Increases Hourly Wages

A general wage increase of two cents per hour for all hourly workers was announced last week by the Consolidated Water Power and Paper Company, effective as of August 18. It applies to employees of the company's four divisions at Wisconsin Rapids, Biron, Stevens Point and Appleton, Wis. The increase was negotiated by company representatives and those of the local and international unions. The base rate of pay now becomes 58 cents per hour, with a starting rate of 56 cents.

Wolf River Project Still Delayed

Further delay is evident in constructing a huge storage reservoir on the upper Wolf River at Lily, Wis., for the benefit of paper manufacturers and water power users of the Fox River Valley. A hearing was to have been held by the Wisconsin Public Service Commission at Madison, Wis., this month granting authority to construct the dam and reservoir. The hearing was postponed indefinitely at the request of officials of the Wolf River Reservoir Company. The project previously had been given approval by the Wisconsin Legislature.

Karl Stansbury Convalescing

Karl E. Stansbury, president of the Thilmany Pulp and Paper Company, Kaukauna, Wis., is convalescing at Memorial Hospital, Antigo, Wis., from injuries received in an automobile accident Monday noon, August 19, at Antigo. He suffered a dislocated elbow, lacerations of the forehead, three fractured ribs and contusions of the knee. He was riding in a car driven by C. R. Seaborne, general superintendent of Thilmany. It swerved off the road and struck a power line pole. Mr. Seaborne was uninjured.

Sperka and Schmidt Nuptials

Harold C. Sperka of Appleton, Wis., and Miss Margaret King of Fond du Lac, Wis., were married Saturday afternoon, August 24, at the home of the bride. Mr. Sperka is production manager for the Thilmany Pulp and Paper Company, Kaukauna, Wis. He is a graduate of Lawrence College, and received his master's degree from the Institute of Paper Chemistry, Appleton, Wis. The couple will reside in Appleton following a honeymoon trip.

William H. Schmidt of Manawa, Wis., who has been assistant microbiologist at the Institute of Paper Chemistry, Appleton, Wis., and Miss Marian Rule of Appleton, Wis., were married Saturday afternoon, August 24, at the First English Lutheran Church at Appleton. Mr. Schmidt has accepted a position on the staff of the University of Illinois, where he will take graduate work toward his doctor's degree while instructing there. The couple will make their home at Urbana, Ill.

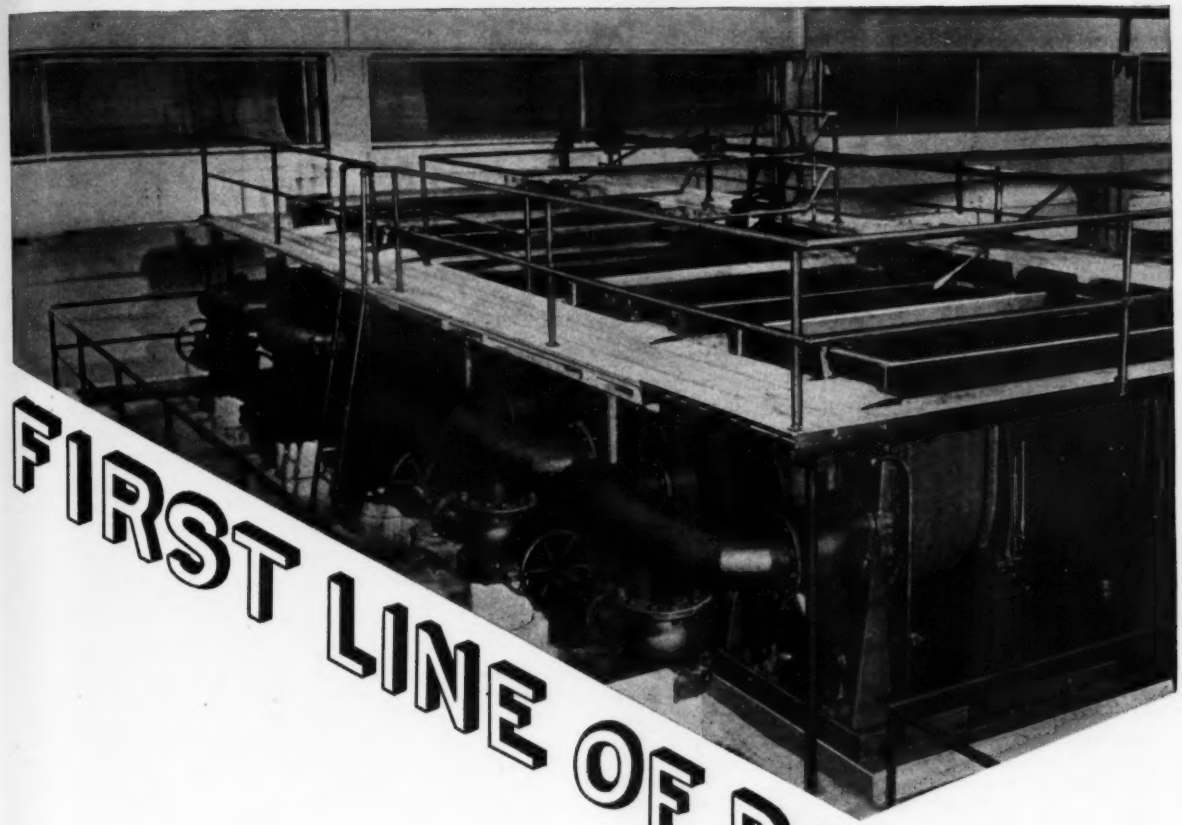
Paper Box Firms Fined

Three defendants in the case of the United States against the National Container Association and sixty-four others accused of conspiring to violate Federal anti-trust laws in the sale and distribution of paper boxes, pleaded no defense to the charges before Judge Gaston L. Porterie in United States District Court at New York on August 22. Those who pleaded no defense were Stevenson, Harrison and Jordan, trade association management firm; its president, Charles R. Stevenson, and C. H. Ferris, an employee. Judge Porterie fined the firm $10,000 and the two men $2,000 each.

A consent injunction whereby all defendants agreed to stop the practices complained of was entered on April 23. By the pleas of no defense the defendants fined yesterday accepted the judgment of the court without actually admitting that they were guilty of violating the anti-trust laws.

Judge Porterie also signed a consent decree in the case of the Kraft Paper Association and thirty-eight co-defendants, including Mr. Stevenson, Mr. Ferris and Scott M. Hudson, secretary of the Kraft association. The decree also prohibits the defendants from continuing their alleged practices in restraint of trade.

The National Container Association and its co-defendants, it was said, controlled 65 per cent of the paper box output, a nation-wide business amounting to approximately $180,000,000 annually. The Kraft association and its co-defendants were said to distribute and manufacture about 85 per cent of the wrapping paper used in the country, a $200,000,000-a-year trade.



FIRST LINE OF DEFENSE

BIG, new Bird Screens put your paper machine in a position to meet 1940 standards of paper cleanness and uniformity, avoid needless and expensive rejects, seconds, complaints . . . This year more obsolete, outworn screens are being replaced by modern, big capacity, fine screen slot Bird Screens than ever before . . . If you're still limping along with old or inadequate screens, ask how little it would cost to replace them.

BIRD MACHINE COMPANY, SOUTH WALPOLE, MASSACHUSETTS

BIRD SCREENS

U. S. Publishers' Stocks of Newsprint Rising

Some Concern Expressed By Canadian Producers At Latest Figures Showing Trend Toward Accumulation of Newsprint Stocks By American Publishers — Newsprint Exports High — Other News.

[FROM OUR REGULAR CORRESPONDENT]

MONTREAL, Que., August 26, 1940—Some concern is being expressed here over figures released by the Newsprint Association of Canada showing a trend towards accumulation of newsprint stocks of American publishers. United States publishers' apparent inventories at the end of July were 501,741 tons, compared with 419,376 tons at the beginning of the month, an addition of 82,365 tons during the month. At the end of July 1939 and 1938 the apparent stocks were 375,411 tons and 445,892 tons respectively.

Opinion on Large Publishers' Stocks

The opinion prevails here that publishers have been accumulating stocks in the belief that a price increase might take place. The fact that the leading producers here have now announced that the $50 level will be maintained for the last quarter of this year and the first quarter of 1941 is expected to offset the trend towards increase in publishers' stocks. If it does not, then manufacturers may be forced to curtail production sharply to prevent a runaway market. There is no reason whatever to anticipate any shortage in newsprint, provided orderly marketing occurs, and that the newsprint operators are determined to maintain, if possible. To this end, of course, the co-operation of publishers is essential.

Newsprint exports down in total but higher to U. S.

July Exports Decline Slightly

Figures just released to the Government show that in July exports of newsprint, while keeping at a high level, were down slightly in volume from June. The total amounted to 6,376,820 cwt., valued at $15,221,529, as compared with 6,413,093 cwt., valued at $15,168,194 in June. They were up sharply, however, from those of July, 1939, when they were 4,003,475 cwt., valued at $8,586,411. Of the total there was a market increase in exports to the United States, which took 5,240,555 cwt., valued at $12,407,615, as compared with 4,927,386 cwt., valued at $11,635,517 in June.

Exports of pulp amounted to 2,077,002 cwt., valued at $6,099,340, as compared with 1,033,995 cwt., valued at $2,297,650 in July 1939.

Pulp and Paper Research Agreement

A new five-year agreement between the Dominion Government, McGill University and the Canadian Pulp and Paper Association for the operation of the Pulp and Paper Research Institute in Montreal is announced.

The institute was established by the association in 1927 to carry on research and development work to improve the Canadian pulp and paper industry in relation to world competition.

Under the agreement, the institute's work will be co-ordinated into one comprehensive plan of research and development. The institute's general administration will be vested in a joint committee comprising representatives of the three parties.

Chairman of the committee is R. L. Weldon, president of Bathurst Power and Paper Company, Limited. Dr. O. Maass, head of McGill's chemistry department, was appointed institute director.

Over 2,000 Observers in Forests

A thoroughly organized intelligence service, known as the Forest Insect Survey has been put into operation by the Dominion Government for the express purpose of keeping unceasing watch over the fluctuations of the insect population of the forest.

Not only the Dominion government but the Provincial Forest Services, the forest industries and the protective associations take an active part in this project. Over 2,000 observers, stationed in all parts of Canada, make regular reports on conditions in their districts. The organization has been operating with increasing effectiveness and success since 1936. In 1939 over 8,000 reports were received in Ottawa. Since the beginning of 1940, notwithstanding the unfavorable circumstances brought about by the war, over 4,500 samples and reports have been received up to the end of last July.

The survey shows that in 1940 the territory invaded by the notorious spruce sawfly has increased somewhat in a westerly direction, new records being obtained from Muskoka and Lake Nipissing, Ontario and Pontiac County and Papineau County, Quebec. Parasites will be liberated in these areas as soon as possible.

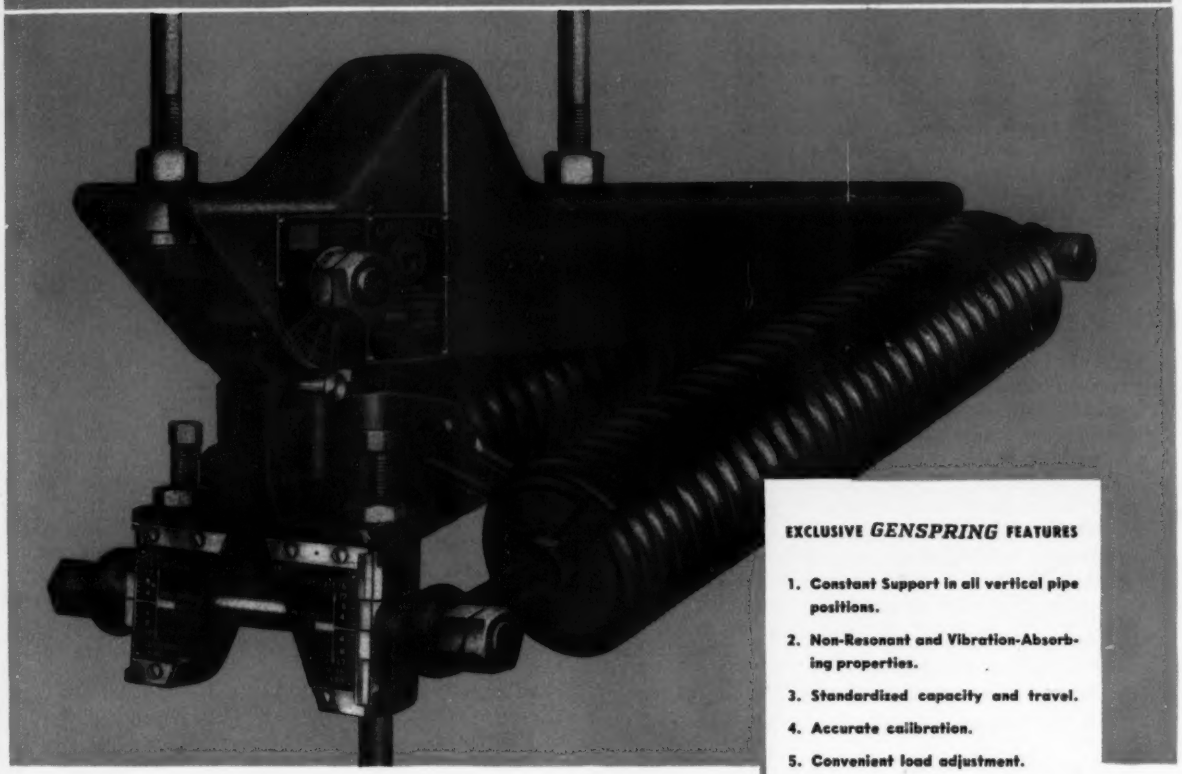
Another important result of the survey consists in the reports on the steady increase of the spruce budworm and the Jackpine budworm in many districts of central and eastern Canada. The latter outbreaks are now under close observations and every avenue of control is being carefully investigated. On the other hand, there seems to be little change in the status of the Larch sawfly as compared with the records of 1939. Bronze birch-borer continues to be a serious pest in the Maritime Provinces. This insect seems to be rapidly increasing in numbers in the eastern townships of the province of Quebec and is quite prevalent throughout central Canada.

Mills to Aid in Salvaging Timber

COLUMBIA, S. C., August 26, 1940—Paper pulp mills in lower South Carolina and Georgia have pledged their cooperation in salvaging timber blown down during the recent storm, according to State Forester H. A. Smith.

He said he had communicated with the Southern Kraft mill at Georgetown, the West Virginia Pulp and Paper company at Charleston and the Union Bag and Paper company at Savannah, and they had agreed to instruct their contractors to pay the same price for fallen timber that they would for standing timber.

THIS CONSTANT-SUPPORT HANGER . "FLOATS" YOUR PIPING



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5. Convenient load adjustment.
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Unique GENSPRING Constant-Support Hangers eliminate weight-stress . . . boost overall safety factors of piping!

Through use of Grinnell GENSPRING Hangers, the weight of the pipe is accurately balanced at all times . . . weight-stress due to thermal movement is practically eliminated . . . and vibration is minimized. For, these unique hangers are precision-engineered to provide constant support and non-resonant vertical movement in all "hot" and "cold" positions of the pipe. They are made to support loads from 250 to 8500 pounds.

No other hanger offers such opportunities for improvements and economies in power piping systems! That's why GENSPRING Constant-Support Hangers are now serving in leading steam plants, in naval and commercial ships, and in major oil refineries throughout the world, after only 3½ years on the market.

Read the seven outstanding advantages of GENSPRING Hangers. Write for data folder, "Grinnell GENSPRING Constant-Support Hangers." Ask for catalog, "Grinnell Specialties for the Pulp, Paper and Chemical Industries." Grinnell Co., Inc., Executive Offices, Providence, Rhode Island. Branch offices in principal cities.

***GENSPRING* CONSTANT-SUPPORT HANGERS BY**

GRINNELL

WHENEVER PIPING IS INVOLVED

Chicago Reports Active Demand for Kraft

More Inquiries For Paper Viewed As Indicating Higher Activity In Midwest Area After Labor Day—Chicago Paper Association Elects—Salesmen Hold Semi-Final Golf Outing—Market News.

[FROM OUR REGULAR CORRESPONDENT]

CHICAGO, Ill., August 26, 1940—The Chicago paper market only mildly moved toward higher ground during the past week. There was, according to reports, only very little actual indication of an upturn in demand although indications of better times to come were apparent in some increases in inquiries. Mills were reported to be cutting their backlogs to the point where production might be slackened noticeably but local commentators felt that Fall business would come quickly enough to avoid any serious readjustments. Kraft papers were reported as active with the market still strong. Sulphites were little changed but, if any thing, were better than last week. Bonds and ledger moved in a narrow groove reflecting the general hesitancy of business in general. Groundwoods and newsprints found buyers more interested, according to reports, and indicated a strong undertone. Books and covers gave some evidence of the Fall pick-up although such improvement was said to be very slight. The board market was slightly stronger. Waste papers were reported as "strong" but spotty with the higher grades doing fairly well. Jobbers were still not moving merchandise in the expected fashion but business was expected to be piling up for a better turn after Labor Day.

C. O. Edgerly Appointed Sales Manager

C. O. Edgerly, a veteran paper sales executive who actually "grew up with the business," has recently been appointed western division manager of the American Paper Goods Company with offices at 1327 West Washington Street, Chicago. Mr. Edgerly succeeds E. N. Whitaker, former western division manager, who died in the early part of June. Since 1922 Mr. Edgerly has been closely identified with the advertising and sales end of the American Paper Goods business and began his career with the well known eastern company as an elevator operator. He is widely known in the midwestern territory which he will now serve as actual director of sales.

Midwest Salesmen at Golf Outing

The Salesmens Association of the Paper Industry got ready to taper off its golf season this week through the medium of the semi-final outing held at the LaGrange Country Club on August 23. More than 80 golfers, a near record breaker, attended the outing held with perfect weather conditions. The attendance was not only a testimony to the hard licks put in by chairman and assistant chairman Patterson and Rolaine but also a gesture of friendship to two swell fellow members, Jack Burrus and Jim Coy. Pat Patterson, Flambeau Paper Company, who is nearing the close of his tenure of office, announced that the final outing would be held on September 26 at the Olympia Fields Country Club as a part of the Fall Meeting entertainment program of the National Paper Trade Association. Lots of prizes, a real sing fest and impromptu evening entertainment and a big attendance are all expected for the event that rings down the curtain for 1940.

Paper Association Elects Officers

After an absence of some years, in which its productive work was genuinely missed, the Chicago Paper Association, an organization of wrapping paper sales executives, gets back into permanent standing this month with the announcement that all temporary officers selected at the re-organization sessions some months ago have been elected for the current year. This means that the coarse paper group will be led by Henry Borchardt, vice president of the Pilcher-Hamilton Company with Robert Levison of the Eagle Wrapping Products Company as first vice president. Samuel Weil, Samuel Weil & Sons, Inc., will act as second vice president while William J. Shapland of the Fred Rentz Paper Company will serve as secretary-treasurer. The organization will be especially designed to cover members servicing industrial and retail accounts.

Fort Wayne Plant Nears Completion

Work on the new Chicago plant of the Fort Wayne Corrugated Paper Company is progressing so rapidly that officials of the Central Manufacturing district last week said it will be ready for occupancy about September 15.

The one story building, to contain 66,000 square feet of floor space, is being built at the southwest corner of Kolin avenue and West 45th street, in the Crawford development of the Central Manufacturing district. It will employ 150 persons.

The investment in land and building will be $160,000. The building was designed by A. Epstein, structural engineer. It occupies a site 300 by 235 feet. The company has an option on 48,000 square feet adjoining for future expansion. The price is $24,000 if bought before June 1, 1943.

The company, which manufactures corrugated paper and fiber shipping cases, now has its headquarters in Fort Wayne, Ind. It has plants in several cities.

Buy Paper Under Walsh-Healey Act

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., August 29, 1940—During the week ended August 10, the Government purchased $218,723.10 worth of paper and allied products under the Walsh-Healey Act as follows: $10,387.08 worth of file folders for Navy Department from Mathers-Lamm Paper Co., Washington, D. C.; $19,084.50 worth of folders for Navy Department from Josephson Manufacturing Corporation, New York, and $189,251.52 (1) worth of wiping paper for Bureau Engraving & Printing from Paper Corporation of United States, N. Y. C.

[1] Indefinite contract other than General Schedule. Purchases to be made if and when needed.

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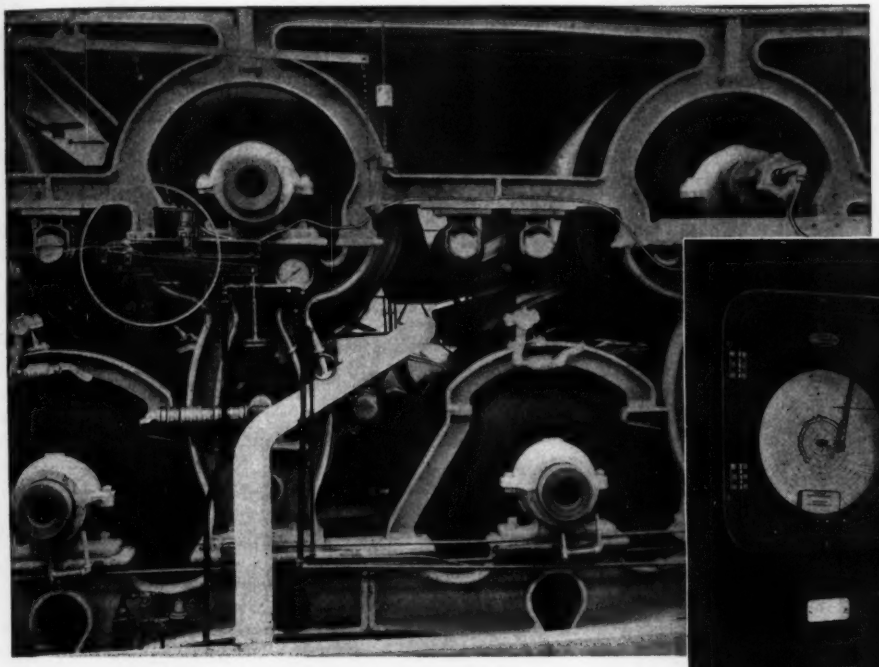
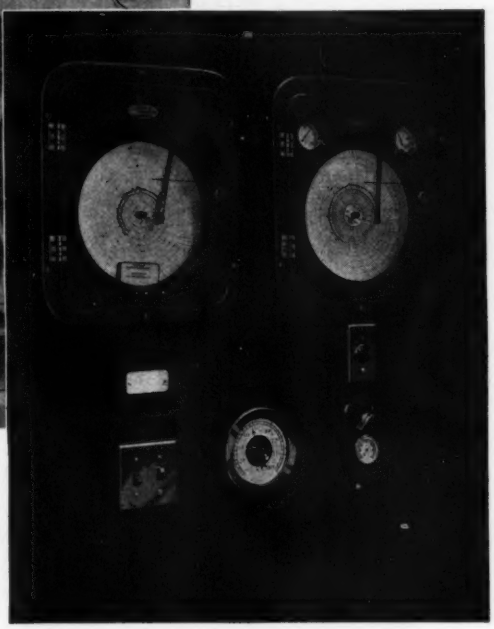
Moisture Control with TENSO-TEMP



Tenso-Temp Controller on the right controls temperature of dryer. Recorder is making permanent record of steam pressure in dryers and engine back pressure.



Tenso-Temp Moisture Control is saving paper-makers money on over half a hundred machines today—through better finish and less waste. Practical engineering has made Tenso-Temp—

SENSITIVE to the slightest variations in moisture content of the sheet. Precise adjustability enables you to maintain any desired moisture up to as high as the sheet will carry.

ECONOMICAL because first cost is low, considering the benefits derived and the excellence of control—and maintenance as well as operating costs are minimum.

ACCURATE because moisture content indication is averaged for the *full width of the sheet;* and response is instantaneous. Thus variations in weight across the sheet do not produce false indication and inaccurate control.

Tenso-Temp Moisture Control can easily be adapted to your present machines. If you are not already familiar with Tenso-Temp it will pay you to investigate. Write for Bulletins.

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REG. U.S. PAT. OFF.

MASON-NEILAN REGULATOR CO.
1181 ADAMS ST., BOSTON, MASS., U.S.A.

New York Buffalo Philadelphia Pittsburgh Chicago St. Louis Tulsa
Houston Los Angeles Mason Regulator Co. of Canada, Ltd., Montreal

Hammermill Agents Hold Annual Meeting

More Than One Hundred and Thirty Paper Merchants From All Sections of Country Make Inspection Visit of Mill Improvements At Hammermill Paper Co., Erie, Pa.—List of Those In Attendance.

New equipment, new lines and new sales programs held the spotlight at the Twenty-Ninth Annual Conference between Hammermill officials and the mill's agents. The conference was held in Erie, Pennsylvania, August 21, 22 and 23.

More than one hundred and thirty merchants attended the three day meeting. Distributors in all sections of the country were represented.

Visitors on Mill Inspection Tour

One of the features of the program was a series of mill inspection trips, during which guides pointed out the most recent developments in Hammermill's constant program of mill improvement and modernization.

The 1940-41 plans of the Hammermill sales and advertising departments took up a big share of the two business sessions at the Kabkwa Club on Thursday and Friday mornings. Both meetings were opened and presided over by Norman W. Wilson, Hammermill's first vice president and general manager.

After Mr. Wilson's welcoming address, talks were given by Donals S. Leslie, vice president and assistant general manager; Harrison R. Baldwin, vice president in charge of sales; A. Ellis Frampton, advertising manager and assistant general sales manager; J. Fred Wuenschel, district sales manager for the Pacific Coast; and G. P. Bothwell, of the Hammermill Cover Specialist.

Mr. Leslie outlined the recent mill improvements which support Hammermill's efforts to keep its papers standard in quality. Mr. Baldwin discussed sales programs, showed sales charts and presented sales award certificates to top-ranking Hammermill agents. Mr. Baldwin also conducted the detailed business of the sessions.

A. E. Frampton Gives Talk on Advertising

At the Friday morning meeting, Mr. Frampton gave a dramatic presentation of how Hammermill's advertising backs up the efforts of the merchants' salesmen. Mr. Frampton showed displays of Hammermill magazine advertising and direct sampling material and demonstrated advertising material to be used this fall.

Committee Members in Attendance

Mr. Bothwell presented new developments in the Hammermill Cover lines. Mr. Wuenschel reported on activities at the Grays Harbor Pulp and Paper Company, Hoquiam, Washington.

Business topics for the sessions were planned by the Agents' Advisory Committee and mill officials who met Wednesday at Weigelia Lodge, the country home of Norman Wilson. Committee members present were: E. P. Magel, Crescent Paper Company, Indianapolis, Indiana; N. K. Woodward, Midwestern Paper Company, Kansas City, Missouri; W. N. Stetson, Jr., Storrs & Bement Company, Boston, Massachusetts; F. P. Leslie, chairman, The John Leslie Paper Company, Minneapolis, Minnesota; J. P. Cunningham, Bradner Smith & Company, Chicago, Illinois; T. H. Epes, Epes-Fitzgerald Paper Company, Richmond, Virginia; George S. Clerk, Hudson Valley Paper Company, Albany; A. W. Green, Green & Low Paper Company, Inc., New York, New York; V. E. Hecht, Zellerbach Paper Company, San Francisco, California.

Members of the Agents' Advertising Committee met with Hammermill advertising men at dinner Thursday. Members of the committee present were: A. W. Green, Green & Low Paper Company, New

PICTURE TAKEN AT THE 29TH ANNUAL CONFERENCE OF THE AG[illegible] HAM[illegible]

York, New York; C. M. Yates, The Dudley Paper Company, Lansing, Michigan; L. V. Mulnix, Carpenter Paper Company, Grand Rapids, Michigan; Douglas Warner, O. F. H. Warner & Company, Inc., Baltimore, Maryland; Ormond Freile, Paper Merchants, Inc., Philadelphia, Pennsylvania.

The following agents were elected to the Advisory Committee to replace members whose terms have expired: E. L. Walters, Western Newspaper Union, Omaha, Nebraska; A. D. Cleveland, E. C. Palmer & Company, Limited, New Orleans, Louisiana; and R. M. Harris, The Alling & Cory Company, Rochester, New York.

New members of the Advertising Committee are: J. H. Brewer, Storrs & Bement Company, Boston, Massachusetts; and C. S. Lafferty, Beacon Paper Company, St. Louis, Missouri.

A beautiful Mexican tray was presented for a drawing by mill men by Elwin Walker of Walker-Goulard-Plehn Company, New York, export agent for Latin America. Bert Claridge won the tray.

The E. R. Behrend Golf Trophy was won by W. N. Stetson, Jr., of the Storrs & Bement Company, Boston, Massachusetts. Mr. Stetson also won the Roger Brooks Taft Memorial Trophy, a gold putter.

The Ross P. Andrews Memorial Trophy, also a gold putter awarded by the visiting agents, was won by C. M. Yates of the Dudley Paper Company, Lansing, Michigan.

On Thursday and Friday afternoons golf, lawn bowling and other competitive games were held. Agents competed for prizes put up by Hammermill men and the latter for prizes donated by the agents.

Paper Men in Attendance

Martin L. Kratz, The Alling & Cory Company, Buffalo, N. Y.; H. S. Kratz, The Alling & Cory Company, Buffalo, N. Y.; Clarence Briggs, The Alling & Cory Company, Buffalo, N. Y.; James E. Alcorn, The Alling & Cory Company, Cleveland, Ohio; H. Kenneth Weed, The Alling & Cory Company, New York; Josef H. Buerger, The Alling & Cory Company, Pittsburgh, Pa.; R. M. Harris, The Alling & Cory Company, Rochester, N. Y.; H. J. Foulds, The Alling & Cory Company, Rochester, N. Y.; B. E. Reeves, The Alling & Cory Company, Rochester.

E. W. Gross, R. P. Andrews Paper Company, Washington, D. C.; G. T. Finnin, R. P. Andrews Paper Company, Washington, D. C., W. N. Schaefer, R. P. Andrews Paper Company, Washington, D. C.; B. R. Moore, Andrews Paper House of York, York, Pa.; M. Kiesewetter, Antietam Paper Company, Inc., Hagerstown, Md.; W. M. Baxter, Jr., The Baxter Paper Company, Inc., Baltimore, Md.; C. S. Lafferty, Beacon Paper Company, St. Louis, Mo.; R. L. Tillman, Beacon Paper Company, St. Louis, Mo.

R. M. Roehm, Beecher, Peck & Lewis, Detroit, Mich.; G. A. Naumann, Beecher, Peck & Lewis, Detroit, Mich.; E. L. Kramer, Beecher, Peck & Lewis, Flint, Mich.; Theodore Greenebaum, Beekman Paper and Card Company, Inc., New York, N. Y.; Nathan Pohly, Beekman Paper and Card Company, Inc., New York, N. Y.; L. A. Ramaker, The Bouer Paper Company, Milwaukee, Wis.; Roscoe Taylor, Butler Paper Company, Inc., Fort Wayne, Indiana; S. B. Gaines, The Capital City Paper Company, Springfield, Ill.

L. V. Mulnix, Carpenter Paper Company, Grand Rapids, Mich.; R. R. Moser, Carpenter Paper Company, Oklahoma City, Oklahoma.; D. A. Hoadley, Carpenter Paper Company, Omaha, Neb.; C. A. Esty, Carter, Rice & Company, Boston, Mass.; G. E. Caskie, Jr., Caskie Paper Company, Inc., Lynchburg, Va.; W. H. Walker, The Central Ohio Paper Company, Columbus, Ohio; A. M. Miller, The Central Ohio Paper Company, Columbus, Ohio; Guin C. Olson, Chicago Paper Company, Chicago, Ill.; C. H. Williams, Clements Paper Company, Nashville, Tenn.

E. P. Magel, Crescent Paper Company, Indianapolis, Ind.; C. Rusie, Crescent Paper Company, Indianapolis, Ind.; F. Dana Payne, The Daka Paper Company, Erie, Pa.; J. M. Knablein, The Daka Paper Company, Erie, Pa.; A. L. Schneider, The Diem & Wing Paper Company, Cincinnati, Ohio; E. H. Joos, Jr., The Diem & Wing Paper Company, Cincinnati, Ohio; T. J. Clancy, The Diem & Wing Paper Company, Cincinnati, Ohio; Walter Joos, The Diem & Wing Paper Company, Cincinnati, Ohio; C. M. Yates, The Dudley Paper Company, Lansing, Mich.

H. S. Wuenschel, Durico Paper Company, Erie,

HAMMERMILL PAPER COMPANY, AT ERIE, PA., AUGUST 22-23, 1940

Pa.; G. J. Kuebel, Jr., Durico Paper Company, Erie, Pa.; G. J. Kuebel, Durico Paper Company, Erie, Pa.; T. H. Epes, Epes-Fitzgerald Paper Company, Inc., Richmond, Va.; J. M. H. Fitzgerald, Fitzgerald Paper Company, Inc., Columbia, S. C.; Merton C. Flemings, Charles A. Esty Paper Company, Div., Worcester, Mass.; A. C. Thomas, F. A. Flinn, Inc., New York, N. Y.; A. W. Green, Green & Low Paper Company, Inc., New York, N. Y.; W. J. Blake, Holland Paper Company, Inc., Buffalo, N. Y.; R. H. Alexander, Holland Paper Company, Inc., Buffalo, N. Y.

G. S. Clerk, Hudson Valley Paper Company, Albany, N. Y.; John B. Binley, Hudson Valley Paper Company, Albany, N. Y.; Sydney T. Jones, Hudson Valley Paper Company, Albany, N. Y.; E. A. Damhorst, Irwin Paper Company, Quincy, Ill.; H. T. Newell, Jr., Jackson Paper Company, Jackson, Miss.; H. G. Keffer, Johnston, Keffer & Trout, Harrisburg, Pa.; J. A. Carpenter, Kansas City Paper House, Div., Carpenter Paper Company, Kansas City, Mo.; Thomas L. Lathrop, Lathrop Paper Company, Inc., New York, N. Y.; Douglas C. Barry, Lathrop Paper Co., Inc., Newark, N. J.; E. Parks, Lehigh Valley Paper House, Div., S. Walter, Inc., Allentown, Pa.; S. Walters, Lehigh Valley Paper House, Div., S. Walter, Inc., Allentown, Pa.

Frank P. Leslie, The John Leslie Paper Company, Minneapolis, Minn.; H. Beckman, Henry Lindenmeyr & Sons, New York, N. Y.; E. E. Cole, Henry Lindenmeyr & Sons, New York, N. Y.; N. K. Woodward, Midwestern Paper Company, Kansas City, Mo.; R. Schmidt, Miller & Wright Paper Company, New York, N. Y.; F. P. Appleton, Miller & Wright Paper Company, New York, N. Y.; Warren White, Old Dominion Paper Company, Norfolk, Va.; A. D. Cleveland, E. C. Palmer & Company, Ltd., New Orleans, La.; C. M. Bleke, The Papercraft Company, St. Louis, Mo.

O. Freile, Paper Merchants, Inc., Philadelphia, Pa.; W. Predmore, Paper Merchants, Inc., Philadelphia, Pa.; H. F. Petrequin, The Petrequin Paper Company, Cleveland, Ohio; E. A. Petrequin, The Petrequin Paper Company, Cleveland, Ohio; N. W. Fort, Jr., The Thomas W. Price Company, Philadelphia, Pa.; J. Strauss, The Reinhold Card and Paper Company, New York, N. Y.; A. W. Rhodes, S. P. Richards Paper Company, Atlanta, Ga.; E. C. Mead, Richmond Paper Company, Inc., Richmond, Va.; C. N. Payne, Richmond Paper Company, Inc., Richmond, Va.

Frank W. Holden, The Rourke-Eno Paper Company, Inc., Hartford, Conn.; John W. Holt, The Rourke-Eno Paper Co., Inc., Hartford, Conn.; J. P. Cunningham, Bradner Smith and Company, Chicago, Ill.; W. L. Shea, Bradner Smith & Co., Chicago, Ill.; G. R. Likins, Springfield Paper Company, Springfield, Mo.; W. N. Stetson, Jr., Storrs & Bement Company, Boston, Mass.; A. J. Stevens, Jr., Storrs & Bement Company, New Haven, Conn.; J. D. Swigart, Swigart Paper Company, Chicago, Illinois; E. R. Carpenter, Swigart Paper Company, Chicago, Ill.; E. Rohrer, Swigart Paper Company.

J. Nacht, Union Card and Paper Company, New York, N. Y.; C. R. Smith, Van Reed Paper Company, Reading, Pa.; C. A. O'Neill, D. L. Ward Company, Philadelphia, Pa.; Ralph G. Luff, D. L. Ward Company, Philadelphia, Pa.; D. Warner, O. F. H. Warner & Company, Inc., Baltimore, Md.; E. L. Walters, Western Newspaper Union, Omaha, Neb.; Mark D. Wilson, R. D. Wilson Sons & Company, Clarksburg, W. Va.; V. E. Hecht, Zellerbach Paper Company, San Francisco, Cal.; Russell Secrest, Central States Envelope Company, Indianapolis, Ind.; E. L. Wood, P. P. Kellogg & Company, Div., Springfield, Mass.

R. L. Allison, United States Envelope Company, Springfield, Mass.; E. V. Johnson, United States Envelope Company, Springfield, Mass.; C. T. Ross, National Envelope Company, Div., Waukegan, Ill.; C. J. Babcock, Batten, Barton, Durstine & Osborn, Inc., New York, N. Y.; S. A. Harned, Batten, Barton, Durstine & Osborn, Inc., New York, N. Y.; Harry Payne, Batten, Barton, Durstine & Osborn, Inc., New York, N. Y.; E. L. Bigelow, Batten, Barton, Durstine & Osborn, Inc., New York, N. Y.

C. C. Walden, Jr., Walden, Sons & Mott, New York, N. Y.; E. C. W. Rueb, Jacobson van den Berg & Company, Netherlands East Indies; H. M. Menzi, Jr., Menzi & Company, Manila, P. I.; Elwin Walker, Walker, Goulard, Plehn Company, Inc., New York, N. Y.; J. Borrell, Walker, Goulard, Plehn Company, Inc., New York, N. Y.; Walter P. Schleiter, Muller & Phipps (India) Ltd., Bombay, India; Wm. H. Howe, W. H. Howe Company, Buffalo, N. Y.; S. J. Robinson, B. J. Ball (N. Z.) Ltd., Auckland, N. Z.

Felix J. Riera, Riera, Toro & Van Twistern, S. A., Havana, Cuba; Pelayo V. Riera, Riera, Toro & Van Twistern, S. A., Havana, Cuba; F. G. Tous, Riera, Toro & Van Twistern, S. A., Havana, Cuba.

Government Paper Bids

WASHINGTON, D. C., August 28, 1940—Government Printing Office has received the following bids for 100,000 sheets of white cloth lined paper; Mudge Paper Company, $79.59 per M sheets, $67.27, $63.16 and $47.82; R. P. Andrews Paper Company, $82.00, $69.30, $65,33, $50.50; Barton, Duer & Koch Paper Company, $80.03, $67.63, $63.50, and $48.08; Whitaker Paper Company, $79.21, $66.94, $62.85, and $47,589; Stanford Paper Company, $82.42, $69.94, $65.41, and $49.52; Mathers-Lamm Paper Company, $80.50, $68.30, $64.13, and $50.00; Middlesex Products Corp., $78.50; and Nashua Gummed and Coated Paper Company, $83.30 less 2 per cent.

Marquette Paper Company has been awarded the contract for furnishing the Printing Office with 22,608 pounds (314,000 sheets) of 34 x 44" yellow sulphite manifold paper at 8.69 cents, bids for which were received on August 12.

Whitaker Paper Company will furnish 93,280 pounds (220,000 sheets) of 34 x 44 single ply white sulphite index paper at 5.58 cents, bids for which were received on July 31.

Mudge Paper Company will furnish 28,000 pounds (100,000 sheets) of 50 per cent rag, 22½ x 28½" white single ply index paper at 11.08 cents and Mathers-Lamm Paper Company will furnish 2,000 sheets of 20½ x 24½ mending tissue paper at $9.50 per ream.

S. Bergstein Gets Board Patent

Samuel Bergstein, 717 South Crescent Avenue, Avondale, President of Interstate Folding Box Company, Middletown, Ohio, has been granted Patent 2211488 for his invention of a new method of forming cardboard egg cartons.

A Record in Forestry

Demonstrating the desirability of directed control and contributing millions of dollars of new wealth to the province, Manitoba's basic natural industry rolled up a record in the past decade in value of standing timber, according to Hon. J. S. McDiarmid, minister, department of mines and natural resources. Through the pursuit of a sound forestry policy, the annual depletion of forests has been maintained at a figure considerably below the annual increment. Each year the excess is added to the forest capital. Today, the province is wealthier by approximately 100,000,000 cubic feet of standing timber in accessible areas alone, than in 1930.

When the province took over its own forest resources 10 years ago, the first step was the amalgamation of two former dominion branches and one provincial branch. This meant that the administration of all forests, whether on forest reserves, vacant crown lands, or on lands awaiting settlement, was handled by one organization. In addition, the Manitoba branch was given full authority in all phases of forestry, including fire protection, timber disposal and reforestation.

Trained foresters, as a result of this co-ordination, were able to give particular attention to those extensive areas of "absolute forest land," which by nature are more suited to the production of tree crops than they are to agriculture, whether these lands lay within or without forest reserves. In administering the forestry resources, the department pursues a policy designed to put the forests to their greatest long-term use. Forests are regarded as crops from which only mature or deteriorating timber and thinnings are harvested annually. Continuous patrols are maintained in order that losses from fire, infestation and wasteful cutting may be kept at a minimum.

Special management and silvicultural programmes are being carried out in each of the six excellent forest reserves of the province. In several instances, management programmes, under which only timber specially marked and selected for cutting may be taken, are well advanced. The aim of the service is to administer the forests so they may produce a perpetual crop, the annual depletion being replaced by increased growth of younger trees. The depletion of forestry areas in the past 10 years has been less than the increment and provided areas of young growth timber can be protected, the present rate of cut can be continued and even increased in the near future.

The ultimate objective in the forest management is to have the permanent forest area divided into working plan units, each of which will be governed on the basis of sustained yield. A working plan was set up on the Duck Mountain Forest reserve in 1934, on the Turtle Mountain Forest reserve in 1937, and on part of the Sandilands reserve last year.

Rules and regulations have also been put into effect on many heavily cut areas outside forest reserves. Cuts have been entirely or partly restricted and young growth areas have thus been afforded opportunity to mature. As a general rule, no timber is cut until it is mature, and all timber areas are examined before cutting to make certain that no immature timber is taken.

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Toledo Scale Company, Industrial Scale Division, Toledo, Ohio.
TOLEDO SCALES

FINANCIAL NEWS

New York Stock Exchange

High, Low and Last for Week Ending August 28, 1940

	High	Low	Last
A. P. W.	2⅝	2	2⅝
Armstrong Cork Co.	31⅛	30½	30½
Celotex Corp.	6⅜	6	6⅜
Celotex Corp., pf.	52½	52	52½
Certain-Teed Products Corp.	4¼	3⅞	4¼
Certain-Teed Products Corp., pf.	23½	21¼	23½
Champion Paper & Fibre Co.	22⅜	22⅜	22⅜
Champion Paper & Fibre Co., pf.	....	....	....
Congoleum-Nairn Co.	16½	16⅛	16¼
Container Corp. of America	13⅞	13⅜	13⅜
Continental-Diamond Fibre Co.	6	5⅜	6
Crown-Zellerbach Co.	14⅝	14	14⅜
Crown-Zellerbach Co., pf.	86	85	86
Flintkote Co.	15	13½	14½
Robert Gair	2⅝	2⅜	2⅜
Robert Gair, pf.	12½	12½	12½
International Paper & Power	15⅜	14½	15
International Paper & Power, pf.	60⅜	56⅜	60
Johns-Manville Corp.	61½	59	60½
Johns-Manville Corp., pf.	125	125	125
Kimberly Clark Corp.	....	....	....
MacAndrews & Forbes	29	29	29
MacAnrews & Forbes, pf.	....	....	....
Masonite Corp.	26½	25½	26½
Mead Corp.	8⅞	8⅜	8⅜
Mead Corp., pf.	....	....	....
Paraffine Companies, Inc.	35	32¾	35
Paraffine Companies, Inc., pf.	....	....	....
Rayonier, Inc.	16⅞	16	16½
Rayonier, Inc., pf.	28½	27⅜	28½
Ruberoid Co.	14	13¾	14
Scott Paper Co.	38¼	37⅜	38¼
Scott Paper Co., pf.	107¼	106½	107¼
Sutherland Paper Co.	....	....	....
Union Bag & Paper Corp.	12⅜	11⅜	11⅞
United Paperboard Co.	....	....	....
U. S. Gypsum Co.	71	68½	71
U. S. Gypsum Co., pf.	182	180	182

New York Curb Exchange

High, Low and Last for Week Ending August 28, 1940

	High	Low	Last
American Box Board Co.	4¾	4¾	4¾
Brown Co., pf.	....	....	....
Great Northern Paper	40½	40½	40½
National Container Corp.	11⅛	10¾	10⅞
St. Regis Paper Co.	3	2⅞	3
St. Regis Paper Co., pf.	63½	62	62⅝
Taggart Corp.	....	....	....

Abitibi Earnings Improve

Profit of the Abitibi Power and Paper Company, Ltd., for July, 1940, subject to audit, and before depreciation and bond interest, amounted to $941,390 compared with $885,862 in June and $191,633 in July, 1939.

Included in above earnings for July, 1940, is $136,735 received as premium on United States exchange.

Shipments of newsprint in July amounted to 46,168 tons according to G. T. Clarkson, receiver and manager, compared with 48,946 tons in June and 22,199 tons in July, 1939. Present indications are shipments of newsprint in August 1940 will be about 39,000 tons, compared with 25,310 tons in August, 1939.

Sulphite pulp shipments in July amounted to 7,472 tons compared with 6,658 tons in June and 2,893 tons in July, 1939. Present indications are sulphite pulp shipments in August will amount to about 7,160 tons as compared with 3,291 tons in August, 1939.

Bondholders' protective committee of Abitibi Power and Paper Company, Ltd., has fixed September 14 as final date for receiving deposit of bonds under plan to terminate the company's receivership through judicial sale of its assets. Sale of property and assets is scheduled to take place in Toronto on October 16. Bondholders, committee reports over 60 per cent of the bonds already have been deposited.

Rayonier Earnings at High Point

Rayonier, Inc., reports the largest quarterly earnings in its history. Net profit for the three months ended on July 31 was $1,593,329, after depreciation, depletion and Federal income taxes under the Revenue Act of 1940, but before any provision for excess profits taxes. This is equivalent, after regular quarterly dividend requirements on the $2 preferred stock on which there are accumulated dividends, to $1.33 each on 963,871 shares of common stock. It compares with net profit of $217,516, or 35 cents each on 626,205 shares of preferred stock, in the corresponding period last year.

Current assets on July 31 amounted to $7,282,119, and current liabilities, $2,491,396, compared with $5,952,411 and $1,705,049, respectively, on July 31, 1939.

The Federal income tax for the quarter was provided for on the basis of the Internal Revenue Code, as amended June 25, 1940, and thus allows for known increases in such taxes but not for any further changes which may be made applicable to earnings for the year as a whole.

Paraffine Earns $1,427,897

Net profits totalling $1,713,019.60 were earned during the fiscal year ending June 30, 1940, by the Paraffine Companies, Inc., compared with $1,427,897.59 in the previous year.

After deducting the cumulative convertible preferred stock dividend requirements, the remaining net profit was equal to $3.40 per share of outstanding common stock, compared with $2.80 per share in the previous fiscal year. At June 30, 1940, current assets were 7.93 times the current liabilities. There was no bank indebtedness.

A. W. P. Nets $31,504

The American Writing Paper Corporation for the six months to June 30 reports a net profit of $31,504, after setting aside $93,774 to provide for interest on the general mortgage bonds, but exclusive of $37,518 profit on these bonds reacquired, which was added to the earned surplus account, compared with $36,447, after deducting $109,342 interest on the bonds for the six months ending June 30, 1939. June quarter: Net profit, $21,625, after providing $64,135 interest on the bonds, compared with $10,127, after $30,380 interest, in the June quarter of 1939.

West Virginia Profits Up

The West Virginia Pulp and Paper Company and subsidiaries for the nine months to July 31 reports a net profit of $1,875,798, after $621,666 premium and expense on bonds retired, equal, after dividend requirements on the six per cent preferred stock, to $1.30 each on 902,432 shares of common stock, compared with $400,280, or $2.57 each on 155,830 shares of six per cent preferred stock, for the nine months to July 31, 1939.

Cut More Pulpwood

[FROM OUR REGULAR CORRESPONDENT]

GLENS FALLS, N. Y., August 24, 1940—The cutting of pulpwood in the Adirondacks has not been increased to any great extent because of present condition, according to a representative of Finch, Pruyn & Co. The company maintains an extensive tract at Newcomb where it obtains its supply, the pulpwood being floated down the Hudson River to the mills here. It was also learned that cutting for the mills of the International Paper Company has not been increased. Most of the pulpwood cut in the Adirondacks for the company is sent by truck to the Corinth mill.

Across the border, however, the cutting of spruce in the Vermont Mountains has increased greatly and wages paid lumberjacks are reported 25 per cent higher than at this time a year ago. There are twelve camps operating in the Bridgewater, Sherburne, Reading and Plymouth areas, the majority of them belonging to E. J. Birmingham & Son. Large surpluses must be consumed at the paper mills before any great rise in the amount of cutting takes place. Trained cutters and strippers, mostly men from New Hampshire and Northern Maine, are able to earn $8 a day in the woods.

Most of the pulpwood is being sent to paper mills at Corinth and other points in New York State. Until recently, imported pulp came largely from Scandinavia and Finland and domestic paper manufacturers who stocked up large surpluses are still consuming the product.

Since the imported product is preferred the paper manufacturers are cautious about increasing their orders for the domestic pulp. If the European situation clears up soon they will be able to tap this source again while a prolonged conflict will result in increased demand for the pulpwood from Vermont.

About 12,000 cords were cut in the Vermont region last year and this amount is expected to be greatly increased this year.

E. E. Nooe Named Superintendent

[FROM OUR REGULAR CORRESPONDENT]

MT. CARMEL, Ill., August 26, 1940—Eugene E. Nooe has been appointed superintendent of the Central Fibre Products Company's plant here, succeeding the late Clarence Hurd, who died a few weeks ago.

THE development of the New Process filling gives Appleton Super-Calender Rolls a full range of density, from the softest cotton through to the hardest paper rolls. This complete selection provides the exact type for the finest finish with maximum service on raw stock, coated or filled stock, embossing or any special application.

Low Water Handicaps Mills

DEXTER, N. Y., August 24, 1940—Several of the large paper mills in this section have been forced to curtail operations to some extent because of low water in the Black River. The Dexter Sulphite Pulp and Paper Company suspended operations all day on Monday and was also closed part of Tuesday. Since then, however, a single machine has been in operation. The firm of Knowlton Brothers, Inc., and the Brownville Board Company are both using auxiliary electric power in addition to the power supplied by the low river to keep the mills working. In both instances the mills are forced to use more auxiliary power than at other times of the year.

United Paperboard Shows Net of $23,559

William S. Stuhr, president, in submitting the annual report of the United Paperboard Company, says, "After providing for all expenses, including Federal Income Taxes payable and depreciation totaling $92,461.79, a net consolidated profit of $23,559.09 was made during the fiscal year. From this profit a dividend of two per cent was paid on the preferred stock. The company increased its capital surplus by $32,149.03 through the purchase of 776 shares of Preferred Stock of the total par value of $77,600 for the sum of $45,450.97 in cash.

"During the year the company increased its merchandise inventory $202,700.64 and its notes and accounts receivable $160,182.36. The increase of merchandise inventory resulted chiefly from the company's policy of purchasing raw materials required for customers orders as soon as such orders were placed without substantially depleting normal inventories. This policy was adopted as a protection against the rising market and threatened scarcity of materials. In addition the company had to manufacture and store larger quantities of its finished products for customers who purchased more than their usual requirements. The increase in accounts receivable was due largely to increased business at higher prices.

"During the past year the company spent $236,828.80 in prosecuting its present program of modernization of its mills and box factories, including the purchase of the Carton Division of the Dobeckmun Company of Cleveland, Ohio, which it transferred to the company's box department at Urbana, Ohio. This purchase included the latest types of folding box machinery. As a part of this transaction, the company also obtained a favorable agreement with Dobeckmun Company for lamination services and the exclusive right to use Dobeco and Dolite boards for paperboard cartons and folding boxes.

"Although the company's proposed improvements have not yet been entirely completed, the company has materially increased its daily production capacity at each of its mills and improved the quality of its products and is now furnishing satisfactory service and quality board to many nationally known concerns.

"The company increased its sales from $2,078,599.27 for the prior year to $2,683,503.44 for the year ending May 25, 1940 and increased its tonnage of paperboard shipped during the same period from 51,832 to 57,498 tons.

"Shortly after the acquisition of the Dobeckmun Carton Division in March, 1940, the company established an additional sales office in Cleveland, Ohio. The company also contemplates opening an office in Chicago in the near future.

"Salesmen are being regularly trained to intelligently merchandise the company's products and several new salesmen have been placed at strategic points to develop territories capable of being economically served by this company."

Goes With Fitchburg Paper Co.

George R. Wallace, president of the Fitchburg Paper Company, Fitchburg, Mass., announces that William H. Kenety will become associated with that company in the capacity of general manager. Mr. Kenety will assume his new position as soon after September 1 as he can complete his duties as director of the Book Paper Manufacturers Association.

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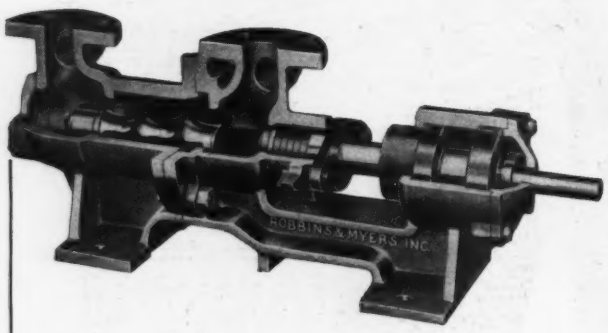

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PAPER
TRADE JOURNAL
Title Reg. U. S. Pat. Off.

Henry J. Berger
EDITOR

Vol. 111 August 29, 1940 No. 9

COMING EVENTS IN PAPER INDUSTRY

New England Section. Technical Association of the Pulp and Paper Industry—Third Friday of each month at the Roger Smith Hotel, Holyoke, Mass.

Delaware Valley Section. Technical Association of the Pulp and Paper Industry—Second Friday of each month at the Engineers Club, Philadelphia, Pa.

Lake States Section. Technical Association of the Pulp and Paper Industry—Second Tuesday of each month at the Conway Hotel, Appleton, Wis.

Kalamazoo Valley Section. Technical Association of the Pulp and Paper Industry—First Thursday of each month at the Park, American Hotel, Kalamazoo, Mich.

National Safety Council, Paper and Pulp Section, Annual Meeting, Stevens Hotel, Chicago, Ill. October 7-11.

National Paper Trade Association, annual Fall Meeting, Stevens Hotel, Chicago, Ill. September 23-25.

NEW TAX ON BUSINESS

In view of the certainty of very large federal expenditures, together with the uncertainty of other forms of revenue, a new and substantially higher tax on business appears inevitable. The subject of taxation is likely to assume increased importance in the future and as a heavy levy on business is also certain to be felt by all who pay any taxes, higher taxes will exert a strong tendency to bring about higher prices in general, smaller business profits and create a more widely diffused knowledge of the effect of taxes on individual incomes. With this situation impending, a more tax-conscious public may, possibly, realize how huge government spending steadily increases the cost of living without proportionately contributing any permanent advantages.

The proposals for additional levies on the American pocketbook certainly will substantially increase the per capita contribution to the federal treasury and with the present cost of government at a high point, the prospect for the future is viewed with some misgivings by private business enterprise. In considering the new proposed tax on business, the excess profits levy, the plans now under consideration would increase the tax costs from 6 to 8 per cent, with various exemption provisions. The Federal Government is preparing to enact legislation which will further reduce profits. The first reduction through laws now in force was the 10 per cent supertax that will be imposed on the 1940 income of both corporations and individuals.

The proposed levy on excess earnings is a special tax on excess profits, advocated on the theory that industries showing profits above a so-called normal should contribute "something extra" to the government. This something extra amounts to about $500,000,000 on 1940 incomes of corporations affected by the proposed levy, above the $1,500,000,000 to be collected by present taxation. This proposal has been approved by the tax subcommittee headed by Representative Jere Cooper, Democrat, from Tennessee. It should be noted that this new excess profits tax is "something extra" and in addition to the existing excess profits tax which is supposed to make effective the tax on capital stock. It may be further explained that the new proposed plan as now considered, exempts all corporations with $5,000 or less income and grants other deductions that would exempt more than 90 per cent of all corporations, by number, from its provisions. It may be also noted that the plan is a preliminary step for increasingly higher taxes on corporate income, similar to the levy adopted by Great Britain, which collects 100 per cent of all corporation net income above that earned in pre-war years.

As the proposed tax is now being considered, the taxpayer is given an option on the choice of excess profit taxes. He can decide to figure his tax on the basis of the amount of capital actually invested in his business, including 100 per cent of borrowed capital up to $100,000, or he can decide to figure his tax on the basis of average earnings for the years 1936-1939 inclusive. Under this taxation scheme a corporation earning less than 10 per cent on its actual invested capital would be better off by accepting the invested capital base of tax, while a corporation earning more than 10 per cent on invested capital would do better by accepting the average earnings base. For example, a tax authority has pointed out that a corporation earning $150,000 this year after it has deducted its federal income tax of 20.9 per cent, or $39,633, may have an actual equity investment of $1,000,000 and may have a record of earning an average of $80,000 a year, or 8 per cent on that capital during the base period from 1936-1939. This corporation then, would be permitted to deduct $5,000 of income from the amount that might be subject to excess profits taxation; then it would be permitted to deduct its base period earnings of $80,000, making a total deduction of $85,000 of income not subject to the new tax. Deducting this $85,000 from the $150,000 of net income would leave $65,000 as excess profit subject to special tax. This tax would begin with 25 per cent on the amount of this "excess profit" that did not exceed 10 per cent of the $85,000 deduction, or a tax of $2,125. It then would rise to 30 per cent on the next 10 per cent, or a tax of $2,550, and would be 40 per cent on all net income above 20 per cent of the deduction, involving a further tax of $14,000. The same tax authority has pointed out that when the income tax return is completed, the corporation would pay, under this plan, an excess profits tax of $19,075 on the $150,000 of net income that remained after paying the regular federal income tax.

In other words, this hypothetical corporation would pay a total federal income tax, plus excess profits tax amounting to 31 per cent of its income, against the existing law which collects a tax of 20.9 per cent.

At this date the House Ways and Means Committee is apparently undecided about the terms of the proposed excess profits tax bill. It appears certain, however, that corporations having a high rate of earnings in relation to the amount of capital in their business, and corporations that have big new profits in relation to net earnings of recent years, will be required to pay a heavy tax.

Increasingly large taxes appears in prospect for what has been called armament taxes. Henry Morgenthau, Secretary of the Treasury, estimates that the Federal Government's deficit in this fiscal year, even with this new tax, will be nearly $5,700,000,000. With the theory that if men are conscripted wealth should also be conscripted, now being heard in Washington, higher taxes on corporation earnings would seem to be impending. In the meantime the long range view of the domestic business situation appears very favorable with the possibility that production will reach a record-breaking volume next year and that the Federal Reserve Board's index of production may rise to 120-125, against an average of 119 in the boom year of 1929.

Damage To Roanoke Mill Exaggerated

The Albermarle Paper Manufacturing Company under date of August 20 sent out the following notice:

"The Sunny South hasn't been very sunny the past ten days!—and our flooded rivers in many instances have recorded new all-time highs. This was especially true of the Roanoke River on which is located our pulp mill and 90 inch paper making machine. The Associated Press, under date of August 19, carried an article in the *Richmond Times Dispatch*—and we understand in other papers that subscribe to their service—to the effect that 'At Roanoke Rapids, N. C., a large plant of the Halifax Paper Corporation burst into flames and was virtually destroyed. Firemen fought the flame from boats.' This was a gross misrepresentation of facts—and later was partially corrected by them.

"A small fire was started in a lime shed by spontaneous combustion which was successfully put out in short order by our own employees with hand fire extinguishers. At this writing much of the plant is under water, but from what we have been able to ascertain the damage is not expected to be very great and we expect to resume operations in a reasonably short time.

"In the meantime we are happy to tell you that orders originally entered for manufacture at our Roanoke Rapids mill have been transferred to our Richmond mills where we have sufficient pulp on hand to take care of your future requirements pending the resumption of manufacture at Roanoke Rapids. Our Richmond mills were in no way affected and are functioning normally."

Production Ratio Report

These statistics are based upon paper production reports to the American Paper and Pulp Association:

COMPARATIVE MONTHLY SUMMARIES[1]

Months	1940	1939	1938	1937	1936	1935	1934
January	90.2%	77.5%	63.9%	90.3%	76.1%	65.8%	.....
February	86.2%	81.7%	68.7%	90.1%	77.9%	70.0%	.....
March	83.9%	84.0%	69.6%	90.3%	76.0%	70.5%	.....
April	86.3%	82.9%	68.3%	92.1%	82.3%	70.0%	.....
May	91.7%	80.2%	69.0%	90.6%	81.6%	69.4%	.....
June	94.2%	79.7%	66.0%	87.3%	80.7%	72.3%	.....
July	87.1%	75.2%	72.0%	81.8%	77.3%	64.9%	.....
August	.....	82.9%	77.2%	82.9%	81.5%	70.9%	.....
September	.....	88.7%	76.3%	78.6%	80.5%	71.9%	58.2%
October	.....	96.6%	82.5%	73.5%	87.6%	75.6%	64.7%
November	.....	97.2%	79.6%	61.9%	88.0%	75.3%	61.7%
December	.....	91.1%	74.4%	54.5%	85.9%	71.2%	59.6%
Year Average	.....	84.9%	72.3%	80.6%	81.3%	70.5%	.....
First 33 weeks	88.6%	80.5%	68.9%	88.3%	79.0%	69.0%	.....

COMPARATIVE WEEKLY SUMMARIES[1]

CURRENT WEEKS, 1940		CORRESPONDING WEEKS, 1939	
July 13	92.6%	July 15	81.8%
July 20	93.1%	July 22	81.1%
July 27	89.8%	July 29	81.7%
August 3	89.1%	August 5	80.5%
August 10	89.8%	August 12	82.9%
*August 17	87.3%	August 19	82.9%

The following statistics show the number of mills reporting by ratio groups:

	Number of Mills Reporting—Current Weeks					
Ratio Limits	July 13, 1940	July 20, 1940	July 27, 1940	Aug. 3, 1940	Aug. 10, 1940	Aug. 17, 1940
0% to 50%	34	39	47	44	43	42
51% to 100%	262	256	247	244	229	180
Total Mills Reporting	296	295	294	288	272	222

PAPERBOARD OPERATING RATIOS

Per cents of operation based on "Inch-Hours" reported to the National Paperboard Assn.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July
1936	62%	67%	67%	70%	69%	70%	69%
1937	80%	86%	86%	88%	85%	77%	66%
1938	54%	60%	61%	57%	58%	56%	57%
1939	60%	67%	71%	69%	64%	67%	63%
1940	71%	70%	69%	70%	76%	79%	72%

Year	Aug.	Sept.	Oct.	Nov.	Dec.	Year Avg.
1936	75%	78%	82%	80%	74%	72%
1937	74%	69%	65%	55%	45%	73%
1938	66%	66%	70%	65%	59%	61%
1939	72%	74%	84%	81%	71%	70%
1940	....	....	....	....	....	....

Week end. July 13, 1940—72%
Week end. July 20, 1940—77%
Week end. July 27, 1940—74%
Week end. Aug. 3, 1940—74%
Week end. Aug. 10, 1940—74%
Week end. Aug. 17, 1940—73%

[1] Production-capacity ratios are based upon six-day capacity ratings which are adjusted periodically to correspond with the ratings reported by individual companies. Ratios are subject to revision until all reports are received.
* Preliminary figure.

Japan Produces Less Pulp

WASHINGTON, D. C., August 29, 1940—Japan's domestic production of wood pulp is falling far short of the goals set in the five-year plan laid down in 1937. According to that plan, production of paper and rayon pulp would amount in 1939 to 1,423,000 long tons, increasing to 1,507,000 tons in 1940. On the basis of reports from pulp producers, it is stated that 1939 actual production amounted to 1,079,000 tons and estimates 1940 production at 1,174,000 tons.

Shortage of electric power and coal have been severe handicaps to pulp producers, augmented by the scarcity of construction materials which has retarded many of the projects for establishing new factories. Furthermore, the Ministry of Commerce and Industry has adopted a policy of refusing construction permits to pulp companies unable to supply their own building materials or whose planned new mills are not actually in process of construction.

PAPER

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Crystal Alum, Potassium • **Salt Cake** • **Trisodium Phosphate**
Sodium Metasilicate • **Sodium Hyposulfite** • **Muriatic Acid**
Sodium Sulfite Anhydrous • **Sodium Aluminum Sulfate**
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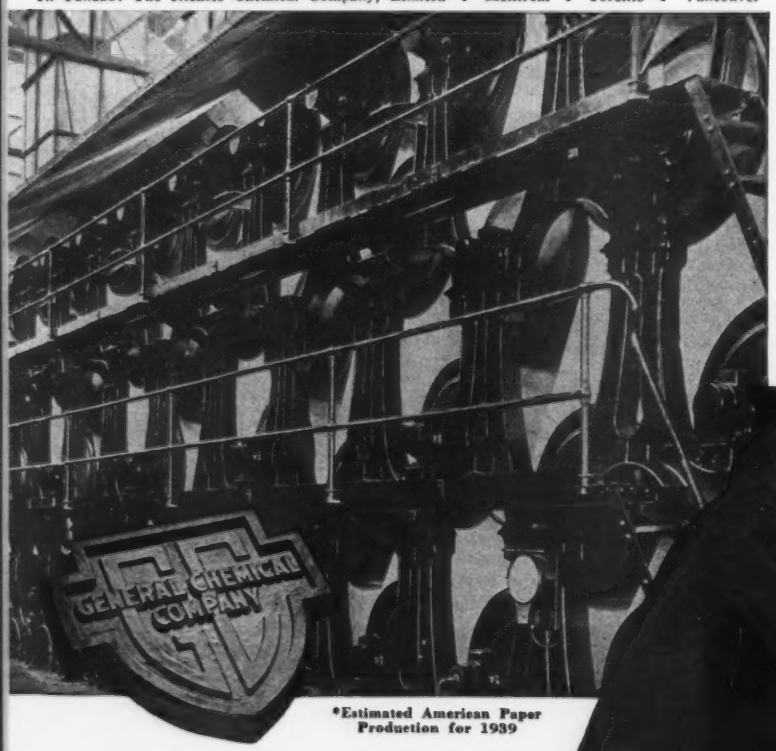
Pacific Coast Sales Offices: San Francisco • Los Angeles

Pacific Northwest Sales Offices: Wenatchee (Wash.) • Yakima (Wash.)

In Canada: The Nichols Chemical Company, Limited • Montreal • Toronto • Vancouver



*Estimated American Paper Production for 1939

Section of the
Technical Association of the Pulp and Paper Industry

Edited by Ronald G. Macdonald, Secretary

Bark Burning Furnaces for the Pulp and Paper Industries*

By C. A. Hulsart[1]

Abstract

The economical use of refuse fuels, particularly bark in pulp mills, has continually increased until today, waste-wood fuel is practically on a par with other fuels. Steam generating equipment is now available for using this fuel either by itself, or in combination with coal, gas, or oil, for any capacity, pressure, and temperature. There are so many variables in even one particular kind of wood refuse fuel that performance predictions for steam generating equipment can be made only on the basis of representative samples of the fuel.

Consideration has been given to the possibility of drying wet wood fuels by utilizing the stack gases. A detail study of the money value of the B.t.u.'s available in the flue gases of modern equipment indicates that there is very little margin of profit available.

In the past decade, the economical use of refuse fuels, particularly bark from pulp mills, has continually increased until, today, industries in which these fuels are available are placing the same importance on efficiency, dependability, and cost of maintenance of the equipment for handling these fuels as is being placed on similar equipment for standard commercial fuels. This departure from the viewpoint that wood refuse is a more or less "nuisance" fuel to the one that it has economic value has been made possible through the development of equipment for the intelligent handling of the problems related to its combustion. Through cooperation between the executives and engineers of the users and the manufacturers of fuel-burning equipment, the importance of waste-wood fuel is practically on a par with other fuels, and steam generating equipment is available for using this fuel either by itself, or in combination with coal, gas, or oil, for any capacity, pressure, and temperature.

Waste Wood Properties

Waste wood is so variable in its chemical and physical properties that each wood-burning installation is an individual problem, and the properties of the fuel must be given individual study for each application. The characteristics of refuse wood are so variable that the general term—"waste wood"—is a misnomer, and some more general term, possibly "fibrous fuels," should be used.

These fuels vary according to:

1. Vegetable growth from which derived
2. Processing performed before reaching fuel bins
3. Physical and chemical changes taking place in the fuel itself during handling and storage.

The divisions under the first heading, "vegetable growth from which derived," would be further classified:

a. The variety of trees, yielding both hard and soft woods
b. The particular part of the tree used—i.e., bark or wood, a mixture of the two, or root growth
c. Grain hulls
d. Bagasse.

Under the second heading, "processing performed before reaching fuel bins," would be divided into the following classes:

a. Bark from dry barkers
b. Bark from wet barkers
c. Hogged fuel from bark removed by slabbing
d. Wood-working mill refuse such as sawdust, shavings, chips, and blocks
e. Refuse from chemical processes
f. Shells, hulls, and chaff from mills processing cereal and vegetable oils.

Under the last heading, "physical and chemical changes taking place in the fuel itself during handling and storage," applies more specifically to hogged fuel and bark refuse from paper mills on the Pacific Coast.

On the Pacific Coast it is the general practice both to transport the logs and store them in water. This means that there is a higher percentage of moisture in this wood than is experienced when the wood is transported overland and stored dry. In addition, if salt water is the means of transportation and storage, considerable marine life accumulates on the logs, and the shells and other residue left by this form of life acts as a flux on the ash and causes very troublesome slag conditions, both in the furnace and on the heat-absorbing surface. It is extremely important that this condition be given serious and active consideration and the equipment be designed accordingly.

In the southeast, wood is generally transported dry, therefore the moisture content is generally much lower than for wood transported by water. However,

* Presented at the Fall Meeting of the Technical Association of the Pulp and Paper Industry, Olympic Hotel, Seattle, Wash., Aug. 20-23, 1940.

[1] Sales Engineer, The Babcock & Wilcox Company, New York, N. Y.

in this section, the timber grows in sandy land and there is considerable entrained sand in the bark. Provision for the removal of as much sand as possible must be made in the design of the steam generating equipment, as well as provision to eliminate the slagging of the boiler heating surface caused by any sand remaining in the bark.

With hogged fuel from slab-removed bark, there is also a variation between the percentage of bark and wood. An analysis of representative samples of western hemlock showed the following ultimate analysis, taking these samples from specimens of all bark and specimens of all wood from the same source:

	All Bark	All Wood
Carbon, %	53.0	51.7
Hydrogen, %	5.6	6.0
Sulphur, %	trace	trace
Ash, %	1.6	1.7
Oxygen + nitrogen, %	39.8	40.6
B.t.u. per pound	9550	8880

While it may not be logical to use a single application for a general engineering basis, it is referred to merely to bring out the problem of variability in this type of fuel and to emphasize the caution with which the use of such fuel should be approached when setting up plant efficiencies, especially where a large investment in dollars and confidence in equipment is involved.

It will be noted that not only does the British thermal unit value decrease on all wood as compared to all bark, but that the hydrogen content increases. This means that with all wood as fuel, the steam production and efficiency are affected by a loss in heat value, also by an increase in loss due to a greater amount of hydrogen. With a greater amount of hydrogen, it would be expected that the British thermal unit value would increase, but on all wood fuel, the British thermal unit value of the combustible material other than hydrogen decreases more than it is increased by a greater hydrogen content. With a fuel having 50% moisture, this makes a difference of approximately an increase in efficiency of 3% for all bark fuel, as compared to all wood fuel.

There is little or no available authoritative information on the effect of aging of bark or hogged fuel,

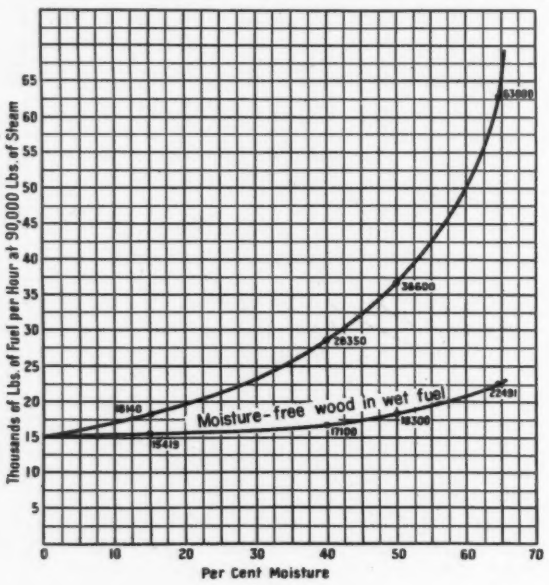


FIG. 1.

and therefore any discussion on this particular feature is quite controversial. However, a recent investigation of this feature has brought out some interesting facts that are here repeated as a matter of interest.

Northwestern hemlock and spruce contain a very small amount of essential oils, little of which is driven off in natural drying, probably a maximum of 0.2%, as most of these oils are driven off only at temperatures that approach that of destructive distillation. These oils come under the general heading of "oleoresins" and they have a heat value of from 18,000 to 19,000 B.t.u. per pound. This would indicate that the phenomenon of combustible gases given off by a large fuel pile is probably due to fermentation or other chemical changes. There seems to be no reliable information available that would indicate any appreciable loss in British thermal unit value due to physical changes occurring while the wood is in storage.

Hemlock on prolonged soaking loses some of its tannin from the bark, otherwise there seems to be no appreciable change as a result of soaking. Tannin is lower in heat value than cellulose, and therefore any loss in tannin would indicate a slight increase in heat value per pound.

As all the foregoing discussion indicates, there are so many variables in even one particular kind of wood-refuse fuel that performance predictions for steam generating equipment can be made only on the basis of one or more representative samples of the fuel. Actual performance can be judged only by theoretical corrections to suit the variables. This means that the steam generating equipment should be designed so that the expected steam output on wood fuel may be obtained with either maximum or minimum heat values of fuels available.

There has been considerable importance given to the possibility of drying wet-wood fuels by utilizing the heat available in the stack gases. A superficial study of theoretical considerations might indicate that material savings could be made by the use of some form of practical equipment for drying wood by means of flue gases. However, a detail study of the money value of the British thermal units available in the flue gases of modern equipment indicates that there is a very little margin of profit available, and further indicates that the cost of equipment and operating expense must be low in order to show any reasonable profit.

Actual Predicted Performance

To point out just what is meant by that statement, the actual predicted performance of a recent application is given. This application consisted of a boiler with superheater and air heater designed to deliver 90,000 pounds of steam at 450 pounds, 725 deg. F. total temperature per hour with fuels of considerable range in moisture content. The performance figures show for the unit:

Moisture in fuel	15%	40%	50%	64.3%
Fuel rate, lb. per hr.	18,140	28,350	36,600	63,000
Wet gas weight per hr.	134,800	157,200	175,500	233,000
Gas temp. at boiler outlet, deg. F.	596	617	634	659
Gas temp. at air heater outlet, deg. F.	374	406	425	460

The relationship between quantities of fuel required to produce 90,000 pounds of steam per hour for varying percentages of moisture is graphically shown in Fig. 1. On this graph is also indicated the amount of moisture-free wood in the wet fuel, the vertical distances between these two curves indicating

the quantity of the water burden in the fuel. In this comparison, the size of the unit has been kept the same in so far as heating surfaces are concerned. The only difference would be in the size of the induced-draft fan required to handle the greater quantity of flue gas, and the greater draft loss caused by the increase in gas weight due to increasing the weight of the dry fuel burned and the additional water vapor in the fuel.

The size of the unit was determined on the basis of the laboratory's analysis of the typical fuel to be used, the moisture content varying from 40 to 50%, the moisture content above and below these percentages being included in the calculations for purposes of comparison. In actual practice, the range of moisture content is predetermined, and the most economical unit, everything considered, is selected. However, the relationship between pounds of steam per pound of fuel would vary only slightly from these figures.

Figure 2 shows the exit gas temperature from boiler and air heater and indicates the amount of useful heat absorbed in the air heater. Figure 3 shows the varying amount of steam generated by the use of an air heater, with varying percentages of moisture in the fuel.

Whether or not drying of the fuel is attempted in the spent flue gases, the air heater is an efficient and economical heat-absorbing unit and is probably necessary in cases where the fuel is dried by the flue gases, for the reason that the air heater will lower the temperature of the gases to below destructive distillation temperatures. If the flue gases in the neighborhood of 600 deg. F. or over are permitted to come in contact with wood fuel, it is reasonable to believe that destructive distillation will take place among the fine particles of fuel and be the cause of considerable loss in heat value. This may be the cause of the high unaccounted-for losses usually experienced in tests on this type of fuel.

With the unit operating on fuel having 40% moisture content, and assuming that the flue gases

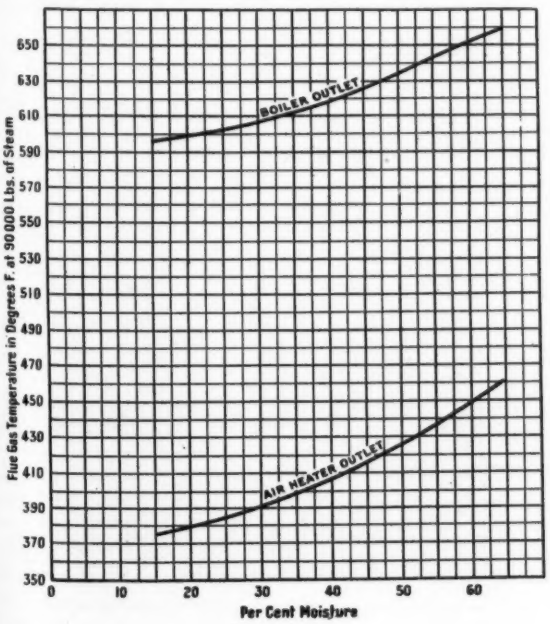


FIG. 2.

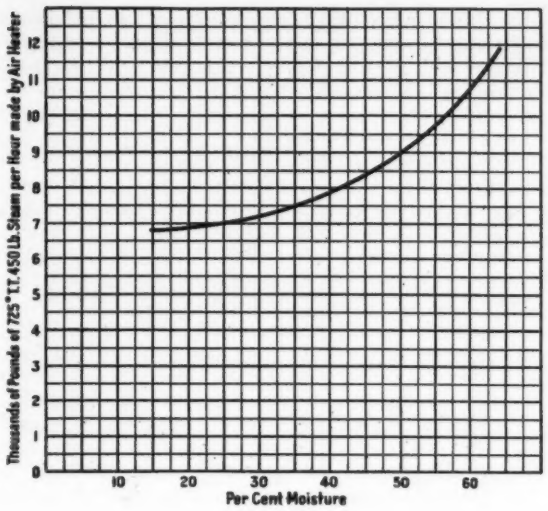


FIG. 3.

could be used down to approximately 255 deg. F. (without experiencing corrosion difficulties in flues) for evaporation of moisture from the fuel in the flue gases, there is sufficient heat in the gases to evaporate 5640 pounds of water.

This means that the 28,350 pounds of fuel with a moisture content of 40% could have an additional 5640 pounds of water as it enters the drier, which is equivalent to 33,990 pounds of fuel with 50% moisture.

Referring to the table of performance figures, it will be noted that, without drying, 36,600 pounds of fuel having 50% moisture is required to produce 90,000 pounds of steam, if the fuel with its 50% of moisture is fired directly to the furnace. Thus, by using a drier, there is a possible saving of the difference between 36,600 and 33,900, or 2610 pounds of this fuel. This represents a saving of approximately only $1.00 per hour on the basis of purchased hogged fuel on an equivalent value of 15 cents per 1000 pounds of steam. This value holds approximately the same for any moisture content above 40%.

Such a small saving does not warrant much capital investment, even though there would be no labor or power necessary to run the drying equipment.

The best way to demonstrate the development of the utilization of this type of fuel is by discussion of significant units installed since 1930. In that year, two significant papers on the subject were presented, one by C. S. Gladden, A.S.M.E. no. FSP53-3, presented at the semiannual meeting of the A.S.M.E. in June; the other by M. A. Hofft, presented at the fifth meeting National Wood Industries in October. For the development of the art prior to 1930, the reader is referred to these papers.

Wood Burning Furnaces

Figure 4 shows a typical water-cooled Dutch-oven-type wood-burning furnace as generally used on the west coast. This unit is that installed by the Weyerhaeuser Timber Company. The fuel is admitted to the furnace through a feed hole in the roof of the furnace and is fed more or less continuously to a conical pile resting on water-cooled grates. The grates are slightly inclined upwards from the rear of the furnace to the front. Air is admitted through the

sides and front of the grates, where the fuel pile is thinest, and the products of combustion and excess air sweep the fuel pile on their way to the heat-absorbing surface of the unit. Combustion of the fuel takes place mainly on the surface of the fuel pile.

The water-cooling tubes of the boiler front wall extend down and across the throat of the wood-burning cells and are alternately bent to form an open water-cooled screen. The upper portion of these tubes are studded and extends below the furnace arch, thus forming a water-cooled nose arch. This construction has the advantage of eliminating maintenance of refractory nose arches.

Figure 5 shows a sloping-grate Hofft stoker. With this type of furnace, the fuel is admitted at the front end over the entire width of the cell and slides downward to dumping grates at the rear of the stoker. The sloping grates are made in three sections, each section being at a different inclination to suit the angle of repose of the fuel at different points, since the angle of repose changes as combustion of the fuel progresses. The first, or upper, section is of solid refractory and acts as a drying table for the fuel before it reaches the intermediate and the third section which is comopsed of open grates through which combustion air is admitted. The grates in the lower section are made in quadrants and act as pushers manually operated from the front of the furnace.

While the figure does not show it, this furnace is also made with water cooling for use with preheated air.

Figure 6 shows the reset installation of the Olympic Forest Products Company. This is typical of several installations made in this district in 1934 and 1935. It is an adaptation of water cooling to furnaces to prevent excessive brickwork maintenance as experienced with all-refractory furnaces.

The steam unit consists of a Stirling boiler having 14,136 square feet of heating surface equipped to give 200 deg. F. superheat at 425 pounds pressure when operating at 200% of rating.

The hogged-fuel furnaces are arranged as Dutch ovens, with cells at both the front and rear of boiler thus permitting the maintenance of the conventional Stirling boiler furnace for burning oil and secondary combustion chamber for burning the volatile material leaving the wood-burning furnaces. The secondary combustion chamber is water cooled on all four sides, with the water-cooling tubes at front and rear extending across the throat of the wood-burning

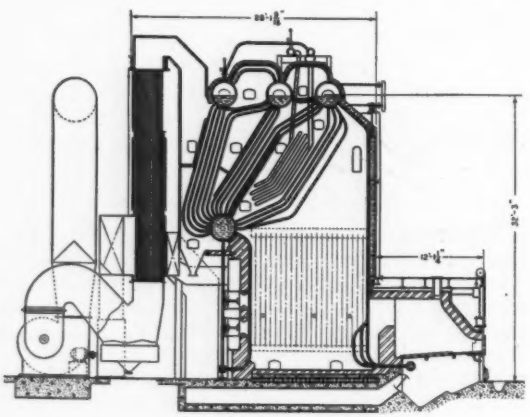
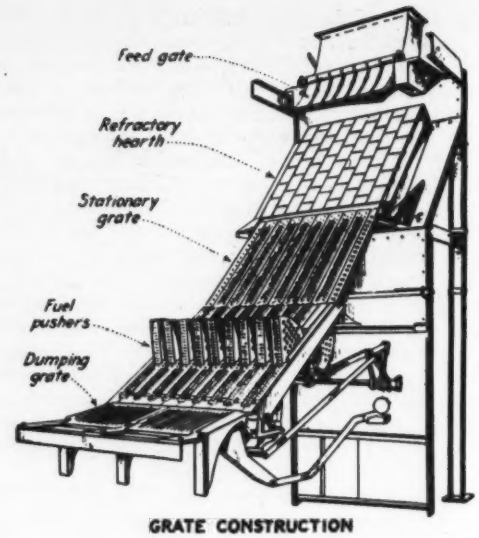


FIG. 4.



GRATE CONSTRUCTION

FIG. 5.

furnaces to form a protecting screen for the wood-burning grates and, at the same time, give water cooling effect at the nose of the furnace arches.

Two oil burners installed in each sidewall of the boiler furnace permit full capacity to be obtained with either oil or hogged fuel, or a combination of both.

Figure 7 shows a unit installed early in 1937 in the southeast, for firing with southern pine bark. This is one of the first units installed with provision for burning the carryover from the wood-burning furnace in the secondary combustion zone.

The unit consists of a Stirling boiler of 11,320 square feet of heating surface equipped with a superheater to give 660 degrees total temperature at 430 pounds gage pressure at the superheater outlet when producing 72,600 pounds of steam with bark firing. The production of this amount of steam requires 23,850 pounds of pine bark having the following analysis which is typical of this fuel:

Carbon	32.20%
Hydrogen	3.97
Oxygen	27.51
Nitrogen + sulphur	0.00
Moisture	36.00
Ash	0.32
	100.00%

B.t.u./lb. as fired—5950

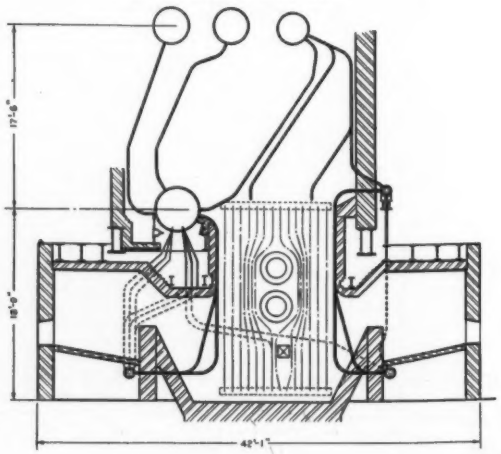


FIG. 6.

The wood-burning furnace consists of three 6-foot cells of the type shown in Fig. 5 (no water cooling). Behind the wood-burning furnace and located at the floor is a refractory hopper with grates extending from sidewall to sidewall equipped with ash and fire doors in each sidewall of the boiler. The carryover from the wood-burning furnace accumulates in this hopper and air under natural draft is permitted to pass through the ash-pit doors in order to burn accumulated carryover.

Integral-Furnace Boiler

While auxiliary oil burners are installed in each boiler sidewall similar to Fig. 4 only the bridgewall under the mud drum is water cooled. This minimum amount of water cooling in the secondary furnace is permitted only because oil is used as an auxiliary fuel for emergency conditions and not as a supplementary fuel to obtain steaming capacity.

The experience gained with units of the types shown by Figs. 4 and 7 indicated the advantages of water-cooled furnaces and the advantage of eliminating the major part of the nuisance caused by carryover from the wood-burning furnace, by burning most of this material in the secondary or auxiliary fuel-burning furnace. This led to consideration of the integral-furnace boiler for this service, as it permits considerable leeway in adapting wood-burning furnaces to the side and burner walls. As the integral-furnace boiler requires much less headroom than standard bent- or straight-tube boilers, it offers an appreciable cost advantage when considering over-all installation costs including building and platforms.

Figure 8 shows one of the first applications of the integral-furnace boiler for use with southern bark in combination with oil firing. The boiler is of 14,100 square feet surface equipped with superheater to give 660 degrees total temperature at 430 pounds gage pressure at the superheater outlet when the unit is operating at 120,000 pounds of steam per hour, 75,000 pounds of which is from bark fuel and 45,000 pounds from oil.

The furnace consists of three 5-foot 6-inch cells of the type shown in Fig. 5 located at the side of the boiler, with the sidewall tubes extending across the furnace throat to form a water-cooled screen mentioned in connection with Fig. 4. The furnace floor is of Bailey block construction.

Provision for burning furnace carryover is made with hollow refractory tunnels extending the length

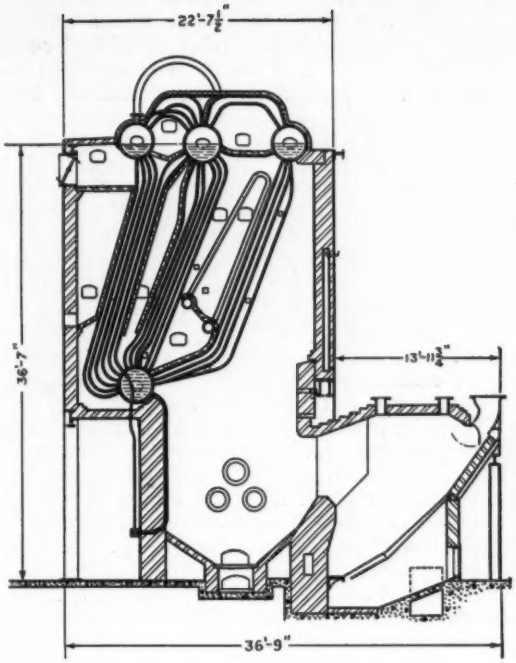


FIG. 7.

of the boiler furnace and parallel to the wood-burning furnace. Slots between brick are left open at the furnace floor for admission of secondary air to the furnace. The hollow section of the refractory tunnel is connected to the forced-draft duct serving the oil burners and is equipped with individual dampers for controlling secondary air to meet variable requirements.

The tunnels act as "snow fences", against which the carryover drifts, and air is admitted through the control dampers to the areas as required for combustion of the carryover material.

All southern pine bark carries a large quantity of sand due to the nature of the soil in which it grows. Some of this sand is embedded in the bark, as it is deposited, during growth, by the wind; this sand is extremely fine. Some coarser sand becomes imbedded in the bark during logging operations. Early experience with this fuel indicated the necessity of bare tube or Bailey block furnace constructions to prevent slagging of sand and ash on the floor. For

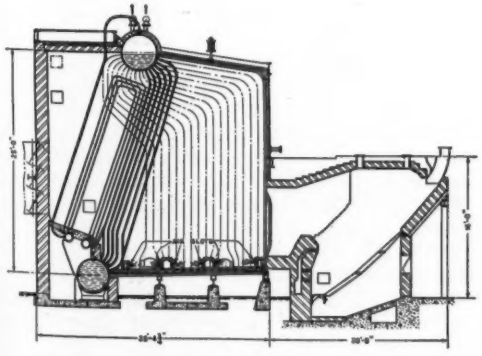


FIG. 8.

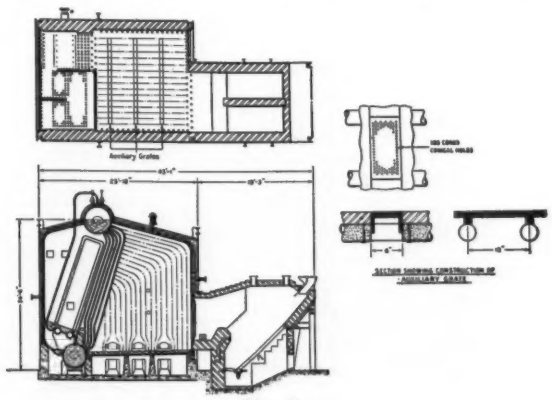


FIG. 9.

that reason the first installations of this construction were made with full Bailey block floors. Later experience indicated that floor tubes on 12-inch centers, with 5-inch thickness of tile as floor remained sufficiently cool to prevent slagging difficulties, hence, this construction is recommended for furnaces using oil and bark in combination.

Figure 9 shows the latest development of the method used for burning the carryover from wood-burning furnaces. The general design of the furnaces is similar to that shown in Fig. 8 with the exception that the refractory tunnels are replaced by three rows of pin-hole grates and, instead of a Bailey block floor, a tube and tile floor is used.

The space below the boiler furnace floor is arranged to provide three separate ash pits supplying air for combustion that enters the pits through ash-pit doors located at both front and rear.

The boiler has 8934 square feet of heating surface and is equipped with a superheater to give 538 deg. F. total temperature at 200 pounds gage pressure at the superheater outlet when the unit is operating at a capacity of 80,000 pounds of steam per hour on combination oil and southern bark firing. The normal design capacity was based on 25,000 pounds of steam per hour on bark and 55,000 pounds on oil. However, this unit has operated satisfactorily continuously at 100,000 pounds of steam per hour of which 60,000 pounds was generated with bark and 40,000 with oil.

The furnace consists of two 4-foot 6-inch cells of the type shown by Fig. 5, located at the side of the boiler, except that this furnace is equipped with water-cooled grates.

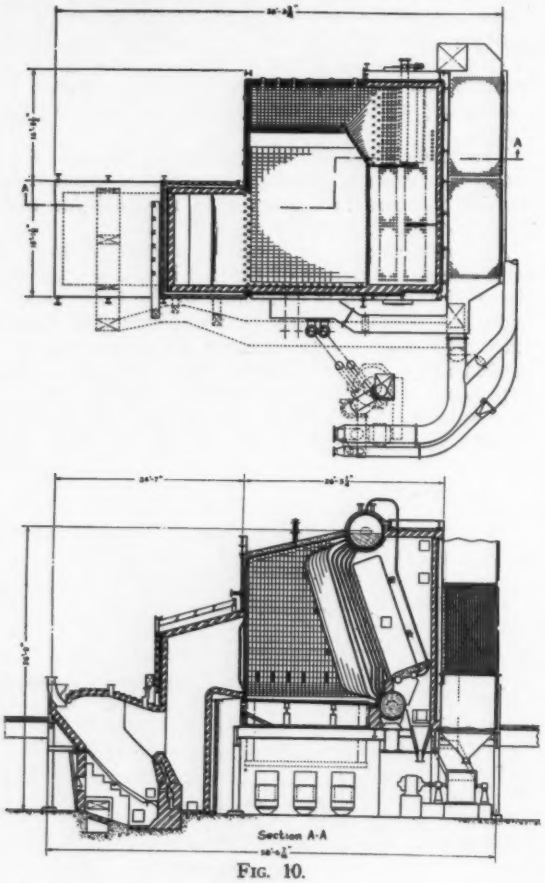


FIG. 10.

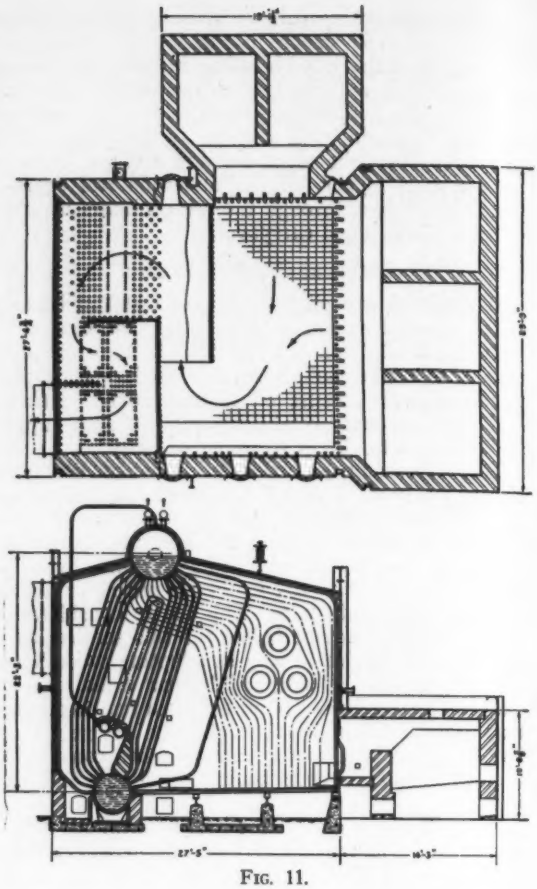


FIG. 11.

Figure 10 shows a unit designed for an ultimate capacity of 170,000 pounds of steam per hour on the basis of pulverized-coal firing and also firing, simultaneously pulverized coal and pulp-mill refuse bark from midwestern spruce and hemlock logs.

WOOD AND COAL FIRING

With wood and coal firing it is necessary that the wood be as completely burned as possible before the carryover particles enter the coal-burning furnace, in order to prevent slagging difficulties caused by the combination of wood and coal ash in the presence of high temperatures.

The wood-burning furnace consists of two 5-foot 6-inch cells of the type shown in Fig. 5, and are located at the side of the boiler; but instead of being located at the same elevation as the boiler, they are located in the basement. This arrangement permits of a large secondary wood-burning chamber between the wood-burning furnace and the boiler furnace. It is in this secondary chamber that most of the carryover is burned before it is admitted to the coal-burning furnace.

The boiler is an integral-furnace unit, with the furnace floor, rear wall, and hopper of Bailey block construction, and the furnace front wall water-cooled, with bare tubes. This arrangement gives the maximum cooling of furnace gases and permits of gas temperatures at the entrance to the first pass that

are less than the softening temperature of the coal ash.

At the entrance to the first pass of the boiler, the water-cooled baffle wall between the furnace and the second and third passes of the boiler is extended out into the furnace, as shown on the plan section, to form a wing wall. This wing wall deflects much of the entrained ash in the gases to the rear wall, where it falls into the hopper at the rear of the furnace.

Little or no difficulty has been experienced with ash removal, with bark and coal firing, the ash being removed periodically to prevent any appreciable accumulation that would act as an insulator on the floor water-cooling surface.

Canadian spruce bark with as high as 75% moisture has been handled satisfactorily for steam outputs of 45,000 pounds per hour but is more difficult to handle than wood fuel of approximately 50% moisture. Operating experience indicates that for fuel of 75% moisture, the capacity on wood should be about 75% of that for fuel of 50% moisture, for comparative operating conditions.

Figure 11 shows a typical unit designed to burn hogged wood from salt water-borne timber for maximum capacity on wood. In addition to the three wood-burning cells at the side of the boiler, there are two cells at the front, with the gas entrance to the boiler immediately under the oil burners.

In the south and east, wood fuel in the pulp and paper industries seldom is available in sufficient quantities to make more than a small quantity of the total steam required, and generally one of the power boilers can handle all the refuse bark fuel produced as a byproduct from wood preparation. This is not generally the case on the west coast, as in this region there is an abundant supply of hogged fuel available from the lumbering industry.

This condition makes it economically obligatory to design steam-generating units so that full capacity is obtainable with hogged fuel and emergency service only with oil fuel. As wood-burning furnaces are somewhat limited in capacity in the width of furnace rather than in depth, it is necessary to increase the total cell width by increasing the number of cells as the boiler capacity increases. This increase in width of furnace is much greater than the corresponding increase in boiler width, and so, to keep the boiler within a reasonable cost limit, the increase in heating surface is made by increasing the height of the boiler rather than the width.

With the Stirling boiler, wood-burning cells may be placed at both front and rear as shown in Fig. 6. With the integral-furnace boiler, additional cells may be conveniently placed at the boiler front, as shown on this figure.

As previously stated, the marine life that accumulates on salt water-borne logs leaves an organic mineral deposit that acts as a flux on the wood ash and materially reduces the ash fusion temperature. This not only results in a destructive reaction with refractory settings but also causes troublesome slagging conditions in boiler and superheater passes. With this condition, it is necessary that the temperature of the gases entering the superheater passes be reduced, if possible, to a point below which this slag remains sticky, in order to reduce the tendency of slag to block the gas passages through the superheater.

To accomplish this desirable result, the boiler furnace is completely water cooled, and, in addition, an idle furnace pass of Bailey stud construction is provided. This idle furnace pass besides providing additional heat-absorbing surface for cooling furnace gases, also causes the gases to change direction in the furnace and thus throw down considerable carryover to the furnace floor, where it can be burned or from which it can be readily removed.

Notes on the Use of Starch in Papermaking*

By B. W. Rowland[1]

Abstract

The growing importance of starch in paper manufacture has become more and more apparent. This appears to be a consequence of (a) improvements in starch technology, (b) new uses for starch in papermaking, (c) the advantage of a control somewhat independent of furnish conditions for special properties and for safer manufacturing tolerances, and (d) better control in the application of starch in paper mills. At the same time, increased efforts have been devoted toward a more adequate understanding of the fundamental colloidal chemistry of starch behavior and the findings reported give promise of an adequate scientific outlook for future technical progress (1). *In the present discussion reference is made only to certain fundamentals which appear particularly essential to the problems of application. An attempt is made to review certain aspects of starch utilization which have become important during recent years, with particular reference to wet end application.*

* Presented at the Fall Meeting of the Technical Association of the Pulp and Paper Industry, Seattle, Wash., Aug. 20-23, 1940.

[1] Research Associate, The Institute of Paper Chemistry, Appleton, Wis.

It is now conventional and appropriate to regard the adhesive qualities of starch as being related to its content of polar hydroxyl groups, the same groups which are now known to play the essential role in the cellulose fiber-to-fiber bond in paper (*2*). In this respect the presence of small amounts of starch in paper should supplement the available cellulose-fiber bond. For the purpose of the present discussion, it is assumed that the starch on the cellulose surface is colloidally adsorbed and constituted of colloidal micelles of amylose. Less perfect distribution of the starch on the fiber surface, such as that reported by Lee (*3*) and observed by him to exist unevenly distributed in the form of spots with extruded amylose in adjacent areas, represents a common example of a somewhat faulty and compromising application of starch, compromising, because to some extent, defective distribution of starch among the fibers may be compensated by improved retention of a mechanical nature owing to the presence of larger and filterable starch particles.

For larger amounts of colloidal starch—i.e., sufficient to form a continuous gelatinous film over the fiber surfaces—it is probable that the cellulose-to-cellulose bond becomes of secondary importance and

functions only as a bond from cellulose to starch to cellulose. In the latter instance, the gelatinous cohesive character of the starch also becomes important. That this may attain a great magnitude has been shown by Seck and Brem *(4)* in their studies of the physical properties of unsupported starch films which, in cases of partial structural orientation, exhibit tensile properties of the order of one-half that of cast iron. To what extent, if any, the starch resident upon the fiber surface may become oriented with respect to the fiber surface has not been demonstrated. It may, however, be supposed that the forces of surface adsorption will effect a certain measure of orientation, at least in extremely thin films.

Although the bond between cellulose and starch has not been quantitatively measured, it must be of a similar magnitude. Between hydroxyl groups there appears to be formed the hydrogen bond, a phenomenon of subatomic energy *(5)*. It appears to be more especially in evidence when the particpating hydroxyls are resident on large molecular aggregations and therefore somewhat immobilized. Thus, the amylose adhesives belong to a class of gelatinous materials containing strongly polar groups acting cohesively as well as adhesively. The properties of other adhesive carbohydrate gums, such as locust bean gum, are similarly derived.

From the fact that raw starch can be dried to form aggregates that easily crumble apart, it follows that (1) either there are relatively few hydroxyls resident on the surface group, or that (2) such hydroxyls as may be present are well occupied with films of adsorbed matter.

It also follows that the addition of dry, uncooked, and unconverted starch to the beater may produce no results at all or will yield improvements in sheet strength only to the extent that some conditions may be present which will very materially alter the starch grains. It is held by some *(6, 7)* that the drying of the starch within the sheet of paper will affect a cooking of the starch, but this is based upon a preliminary partial gelatinization. It seems important in this connection to point out that if starch in water suspension undergoes a very rapid elevation of temperature (from room temperature to the boiling point), there is apparently no cooking of the starch. This observation can be made readily in test tubes. It appears that the starch must pass through an intermediate swelling zone if it is ultimately to disperse in the cooking reaction. The point is of particular interest with reference to the Bradner process which involves a rapid elevation of temperature of the raw starch. Presumably the starch is partially gelatinized in this method and further cooked as the sheet dries. Beating and jordaning will have little or no effect in the dispersion of raw starch, and it remains ordinarily for the steaming action on the driers to affect whatever cooking action may eventually be accomplished. That this does not occur to any important degree, at least in ordinary weight papers, may be readily established by inspection of a sheet of paper made with raw starch in this manner. The starch is present in discrete particles and predominates on the felt side; and while a slight cooking action may have taken place, it is far from sufficient to be of importance. For very heavy sheets and board, the effect is somewhat greater and an appreciable reinforcing effect may be accomplished.

The intermediate swelling of starch grains during cooking involves a large increase in external surface, and the simultaneous appearance of an increased adhesiveness results from the formation of a more surface-active exterior, probably owing to the exposure of hydroxyls in a manner similar to that occurring in the hydration of cellulose. Starch grains swollen at the intermediate cooking temperatures (65 to 75 deg. C.) are still surprisingly tough, although greatly attenuated. They may be put into handsheets and the wet handsheets subjected to a pressure of 15,000 pounds per square inch without becoming broken. Apparently they are more readily broken by a shearing stress. That jordaning will disrupt them to some extent is apparent from inspection of paper made through the use of swollen beater starch, although cooking on the drier is also involved. Our experience indicates that for a given set of mechanical conditions, especially jordan setting, the starch may be introduced in such a precise condition of swelling that the mechanical action is just sufficient to disrupt the starch particles and the anticipated beneficial results are obtained. Rupture of the swollen grain and a liberation of the soluble amylose renders available the adhesive potentialities through the amylose hydroxyls. If, however, the forces of mechanical disruption are too intense, much of the effectiveness of the starch is lost—a consequence of too extensive structural breakdown of the amylose gel, probably resulting also in lower retention. Optimum results in the use of semicooked starch thus becomes dependent upon a rather critical set of conditions and the precise condition of the starch when furnished. Any alteration of the mechanical conditions will then throw the starch condition out of adjustment.

If the starch is completely cooked before addition to the beater, even mild jordan action will mechanically destroy the amylose gels to such an extent that retention and adhesive qualities are apparently damaged. These effects may be noted in handsheet work using a colloid mill in place of the jordan. In an effort to toughen the starch to such a degree that jordan breakdown of starch will not be too extensive, we have modified starch with toughening agents, such as formaldehyde, so that it is more readily possible to adjust the starch to a given set of operating conditions *(8)*. The purpose of the application of the formaldehyde-treated starches is that it permits of a more thorough cooking of the starch without at the same time reducing the starch to a dispersion, which subsequently is completely broken down by the jordan action. Similar results are obtained by Roberts *(7)* who prepared the starch with gelatinization inhibitors.

In the cooking of starch it appears from the data of Houtz *(9)* in our laboratory that optimum conditions of cook are attained immediately after the swollen starch grains are broken. This point is reached for tapioca at 88 to 90 deg. C., and for cornstarch at 93 deg. C. Houtz used a consistometer similar to that of Caesar *(10)*, and followed the colloidal changes during the cook with soap-starch viscosity measurements, and changes in macromolecular weight in zinc chloride solution. These soap-starch viscosity phenomena were first pointed out by Richardson and Waite *(11)* and extended by Heald *(12)* in our laboratory. It was observed that the higher the molecular weight of the dispersed starch, the better were the effects of starch in handsheets. To what extent the molecular weight influences retention and to what extent it relates to intrinsic adhesive value were not determined. Quite possibly both factors were in-

volved, but until better methods for measurement of starch retention and of the adhesive strength of starch in paper can be found, the two cannot be quantitatively evaluated. Prolonged cooking causes a gradual degradation in viscosity, molecular weight, and effectiveness as a beater size.

The soap-starch viscosity relations studied by Heald serve to differentiate technical and colloidal differences in starch preparation such as are not observed in the usual viscosity tests. These viscosity differences are enormously accentuated by the addition of 12% of sodium oleate to the 0.5% starch sol; the degrading action of overcooking, overconverting, and mechanical action on the colloidal structure can readily be followed by these procedures.

Modified or cold water-soluble starches continue to be employed in the beater. The effectiveness of a given starch will depend not only on its type but also on the mechanical features of the operation. Some of these modified starches are effective, and certainly this is the most convenient method of starch application to the wet end, as it obviates the cooking operation. The cooking operation may, however, be greatly simplified as, for example, by the continuous injection of starch into hot water and thence to the furnish as developed by Swett *(13)*. For this purpose easy-gelatinizing starch compositions are employed.

In the Swett cooking procedure, the uncooked starch is first made into a 3 pounds-per-gallon slurry in cold water, usually with a small amount of cooked starch present to prevent settling. It is then run at a constant rate through a metering device into a cooking chamber which in turn is supplied at a constant rate with water at 200 deg. F. The hot starch is then led to the paper machine, generally to the fan pump. The obvious advantages of this cooking process include the possibility of rapid adjustment of the quantity of starch furnished, and the elimination of the troublesome batch cooking operation with its labor costs and hazards.

In the opinion of the writer, the use of starch after the jordan with special control, constitutes the most effective procedure for wet end application. These views were expressed a number of years ago *(14)*, and subsequent experience has further supported statements made at that time. In the intervening years a number of installations have been made for properly cooking and precipitating starch in the furnish after the stock has passed through the severe mechanical action. The developments have unfortunately been somewhat clouded by patent matters, but this has now become clarified by a recent issue to the writer *(15)*, this patent dominating the pertinent features of a patent previously issued to others *(16)*. The technique consists essentially of three important features: (1) the proper preparation of the starch, (2) the precipitation of the starch with the correct amounts of alumina hydrate, preferably formed in the furnish after the starch addition has been distributed throughout the furnish, and (3) the whole operation taking place after the jordaning. Under these circumstances the starch may be furnished in an ideal colloidal state, which is not subject to serious alteration subsequently. For this purpose the starch is cooked just past the bursting point of the swollen grains. After the starch is distributed in the furnish, alumina is generated by the addition of an alkali, such as caustic, sodium aluminate, or silicate, and the pH subsequently adjusted if desired with further alum. The pH should finally be somewhat above that range at which alumina will redissolve in considerable amounts, although fair results have been obtained even at relatively low pH's.

Not only has this development been retarded by the necessity of somewhat more than the usual amount of legal defense, but it has also, and in the same confusion, been somewhat misinterpreted technically. It should be noted, for example, that aside from matters of economy or convenience, there is no particular choice between any alkaline material to be added to the furnish in order to generate hydrous alumina for starch precipitation. Furthermore, insofar as the starch effect is concerned, there is no critical necessity of precise control of pH in the white water and for reasons that will be mentioned later, it is clear that pH control is not the key to the complex set of conditions present. In fact, the pH of the white water can range between considerable limits if other conditions are favorable.

Unless some agency, such as mechanical filtration or a precipitating agent is present, starch is not extensively held to the surface of the pulp fibers. In fact, the same forces which are desirable to keep fiber bundles separated will act in the same way to reduce the effects between the starch and the fibers, although starch may be strongly adsorbed in surface films *(1)*. Theoretically, a relatively small amount of starch would be sufficient to cover the fiber surfaces to a depth of one particle or micelle in thickness. The smaller the micelles, the less required. This would be in agreement with the findings of Cobb *(17)*, who states that maximum strength through the use of not greatly degraded starch is about 0.5%. Our experience, however, is that, at least with starches cooked as described and effectively precipitated, much more than this amount of starch can be used to advantage. In fact, the reinforcing effect seems to become disproportionately improved up to 4 or 5% as compared with the addition of 1 or 2% or less. These results are with reference to Fourdrinier sheets. Proportionate increments in sheet strength have been developed even with starch additions beyond 5%. However, larger additions, together with appropriate amount of alumina hydrate to insure good retention, tend to slow the sheet considerably, and this slowness may place a limit on the quantity of starch that can be used in a given case.

It appears that in many instances an undue importance is placed on the retention of starch. Not even excepting matters of economy, the overall advantages of starch additions involve not only retention but the effectiveness of such starch as is retained but also its distribution through the fiber mass. Thus, it is obviously possible to have a high retention of improperly prepared starch showing poor reinforcing action in the sheet and being held by filtering action, nonuniformly distributed through the sheet. Our preference, accordingly, is to so prepare and add the starch that it will be attached to every fiber in the furnish and in this way to insure an even starch distribution through the sheet. If, under these conditions, the starch is present in a form such that the adhesive properties have not been impaired by chemical or mechanical action, the strength improvement in the sheet, especially burst and fold, is remarkably good, and in the opinion of the writer, the best obtainable by starch. In general, it appears more readily possible to secure high burst rather than high fold, the latter property being more impaired by errors in starch preparation and application. Fold,

however, may be surprisingly improved and maintained when these conditions are satisfied.

Many of these points in regard to the wet end application of starch have been reported previously and are not news in the field. If the emphasis appears unnecessary, it must still be noted that in many cases where starch usage has been found to yield unsatisfactory results, one or more of these fundamental requirements has not been met. In addition, there are certain local conditions which may adversely influence the starch effect. Among those conditions which have come to our attention is that of the presence of excessive quantities of hydrous alumina which, for example, results from the use of extremely hard water, requiring the use of 4 or 5 per cent of alum on the weight of the furnish. It appears that the starch gel becomes so fully occupied with the preponderance of positively charged alumina that its adhesive polar nature is no longer available for the cellulose interface.

The function of alumina, particularly with reference to its electropositive nature in relation to the role which it plays in the sizing of paper, is now generally recognized. The acidity which is established by the sulphuric acid derived from the alum, however, will not only reduce the hydrolysis of the alum, but will tend to discharge and to agglomerate the alumina by virtue of the sulphate ion concentration. Both of these effects will influence the quantity and effectiveness of the alumina present. The pH is thus of some importance, although, within the usual papermaking range of acidity, it is a relatively small influence on the characteristics and precipitating power of the alumina with reference to starch as compared with the activity of the sulphate ions. Furthermore, pH does not measure the concentration of the sulphate ions nor does it give any indication of the amount of hydrous alumina present. If, in a given instance, the nature of the furnish and operating conditions are such that the available alumina is preferentially being withdrawn from the system with reference to the sulphate and acidic constituents, free acid will accumulate at the wet end and the pH will not be an adequate index, as it would lead the operator to furnish less alum and thus aggravate the difficulty. In fact, as pointed out elsewhere by the author *(18)*, the papermaking system gives rise to a very complex set of colloidal equilibria conditions, the pH being only one of several important factors and in itself insufficient and in certain cases actually misleading. That the various pulps themselves will participate in these equilibria has also been pointed out. That even the hydration of the pulp will augment its affinity for hydrous alumina to a great extent has recently been observed by Allison *(19)* in our laboratory. For these reasons, emphasis must be placed upon the importance of a careful consideration of specific cases in order to insure better and uniform sizing, not only with starch but with rosin as well. Fortunately, in the average operation no conditions prevail such as are severely adverse toward good starch results, but in the exceptional cases, factors are obviously involved such as will require special consideration, and the necessary corrective steps.

The increased use of starches in tub sizing and coating, the latter particularly with reference to so-called machine coating, could be mentioned as of importance. The use of starches for these purposes, however, involves distinctive and separate consideration from the wet end application, and is mostly a matter of the special and peculiar characteristics of the various modified starches which have been made available for these purposes. The problems are those of suitable modification of the starches themselves and the general trend is towards a monodispersed or uniform breakdown in the converting operation. It appears worthwhile to mention again that the soap-starch viscosity effects previously referred to would seem to offer a much needed technique for following in a critical manner the progressive changes in the colloidal characteristics of starch in the processes of modification, whether by oxidation, enzymes, etc. The Richardson method *(20)* of viscosity of starch in 30% calcium thiocyanate, and the strength testing methods of Saxl *(21)* should be most helpful also. Much important technical progress is currently being made in this field, and it is hoped that the starch chemists will generously keep us informed of their progress.

As reported by Strasser *(22)*, procedures in our laboratory have provided an adequate method for the evaluation of tub starches without the difficulties and expense of paper-mill trials. The method consists in passing a sheet through a temperature-controlled starch bath at constant speed and pressing it between rubber rolls with adjustable pressure at the nip. For the purpose of long term comparative experiments, a large quantity of all-rag paper was made and cut into 6-inch rolls. The purpose of the all-rag furnish was to provide sufficient fiber quality so that various tub starches could be more critically evaluated. These procedures have been found most helpful in the investigation of starch conversions and in the adaptation of starch for special purposes.

As in the tub-sizing field, the possibilities of starch application in coating depend largely upon the inherent characteristics of the starch rather than upon the method of application. The large consumption of modified starch in the rapid machine-coating field is a notable advance in starch application. Brush coating mills are now showing a definite trend toward starch as the coating adhesive, a departure which has been greatly encouraged by the development of special starch modifications to give high strength and to influence favorably the flow properties of the coating color. In this field also the papermaker will generally await with interest the advances on the part of the starch technologists.

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Cross Sections of Pulp Fibers*

By John H. Graff,[1] M. A. Schlosser,[2] and Eda K. Nihlen[3]

Abstract

Cross-sectional areas of pulp fibers are distinctly different and change with the degree of cooking and purification of the individual pulps. As microtome cuts from two different mounts of the same pulp check comparatively well, the number of fibers per unit area, the relative volumes of the gross and net areas, the areas of the lumen and the voids between the fibers, and the total surface areas for the fibers of a given unit weight should be valuable data for a better understanding of beating, sizing, dyeing, retention of fillers, and felting characteristics of pulps, if a dependable method of obtaining these data can be developed.

Anyone who has made a study of the cross sections of fibers from paper cross sections has seen that they differ considerably from cross sections of fibers seen in wood sections, therefore, a more thorough study of cross sections of pulp fibers made from pulps having various characteristics was made. The following pulps were selected:

1 Softwood unbleached jack pine kraft
2 Softwood unbleached southern kraft
3 Softwood Duracell
4 Softwood Cellate
5 European softwood unbleached kraft
6 European softwood bleached kraft (Pulp 5 bleached at the institute)

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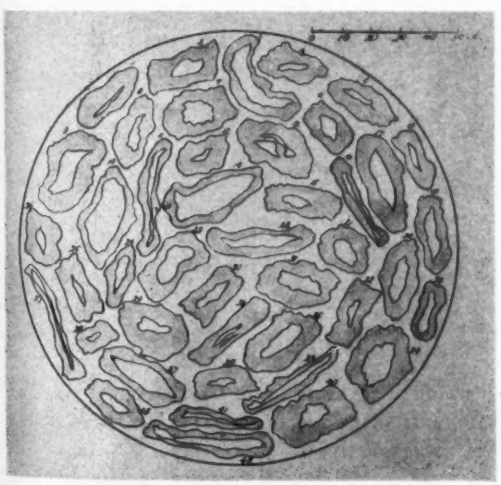

Averages

Width, mu	28.40
Thickness, mu	12.70
Width/Thickness	2.23
Gross Area, mu²	269.00
Area of Lumen, mu²	57.80
Net Area, mu²	211.20
Roundness Factor	44.75
Perimeter, mu	106.50

FIG. 1.
No. 1 Softwood Unbleached Jack Pine Sulphate

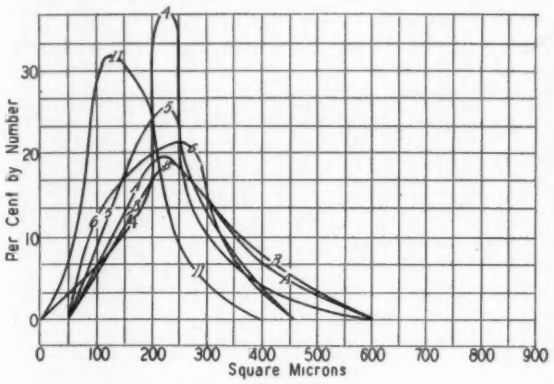

FIG. 2.
Frequency Distribution of Gross Cross Section Area of the Fibers

7 Softwood unbleached Mitscherlich sulphite
8 Softwood bleached sulphite
9 Softwood unbleached western sulphite
10A Softwood bleached western sulphite
10B Softwood bleached western sulphite (same pulp as 10A)
11 Softwood regular alpha
12 Softwood N.N. alpha

A small number of fibers were straightened out and bundled together parallelly with their ends overlapping at intervals, desiccated, and mounted in paraffin. From these mounts, 5-micron cross sections were prepared, and drawings were made from them at 1000 diameters as shown in Fig. 1.

Some of the cross sections gave the impression that the fibers had two lumens, but this is caused by the growth layers being pushed apart during cutting.

From the drawings, measurements were made of the width and thickness of the cross sections of each fiber. The gross area of the fibers and the area of the lumen of each were determined by means of a planimeter, and the roundness factor and perimeter of the fibers were calculated.

The roundness factor is the gross area of the fiber divided by the area of a circle whose diameter is the width of the fiber and multiplied by 100 (for expressing the value in per cent); the larger this factor, the rounder the cross section of the fiber.

The perimeter was calculated by the equation $[2\,(\text{width} + \text{thickness}) + (\pi\ \text{width})]/2$.

The average of these calculations was noted as is shown in Fig. 1. The frequency distributions of the determination of the gross area, the area of the lumen, and the roundness factor of the individual fibers for each pulp were determined. These frequency curves showed that there is a distinct difference in the cross-sectional characteristics of the various pulps, however, the question arose as to whether this was actually true or merely accidental. For the purpose of verification a new mount of fibers was made from Pulp 10A, and cross sections, drawings, and calculations were made from the second mount. This mount was designated as Pulp 10B, and the curves, *A* and *B*, in Fig. 2 show that the frequency distribution of the gross cross-sectional areas of these fibers was exactly the same as those obtained from the first mount. There was very little difference between the frequency distribution of the roundness

factor of the fibers in the two sets as can be seen by the curves, *A* and *B*, in Fig. 3.

In comparing the frequency distribution of the gross cross-sectional areas and the roundness factors of Pulps 5 and 6 [European unbleached and bleached kraft (*see* Figs. 2 and 3)], it was of interest to note that the bleaching did not change the frequency of the gross area to any extent; however, the frequency of the roundness factor had been changed considerably, from which it appears that bleaching tends to increase the roundness of the fibers.

Having obtained these data, the drawings of the cross sections of the fibers were then placed side by side in cordwood fashion in a unit area (163 by 84.5 microns) until filled. The fibers were always taken in numerical order (*see* Fig. 1) with no regard to selection and fitting in special spaces. The results for some of the pulps are shown in Fig. 5.

From the data so far obtained, it was possible to determine the number of fibers per unit area of each pulp and the percentage of gross and net areas of the fibers, the percentage of area of the lumen, and the percentage of air space between the fibers in a given unit area, together with the specific surface, which is the average perimeter of the fibers multiplied by the number of fibers in a given unit area. The averages calculated from the individual sections of the fibers with the unit area factors have been noted for each individual pulp, and these factors with the average fiber lengths for all the pulps have been tabulated (*see* Table I).

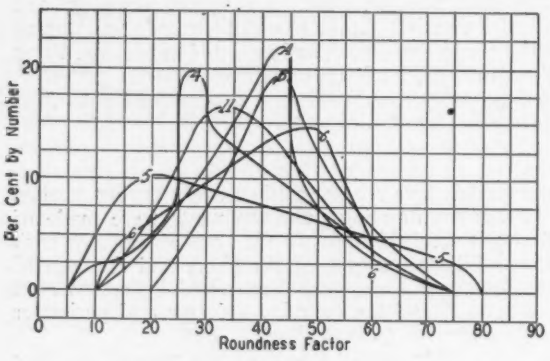

FIG. 3.
Frequency Distribution of Roundness Factor

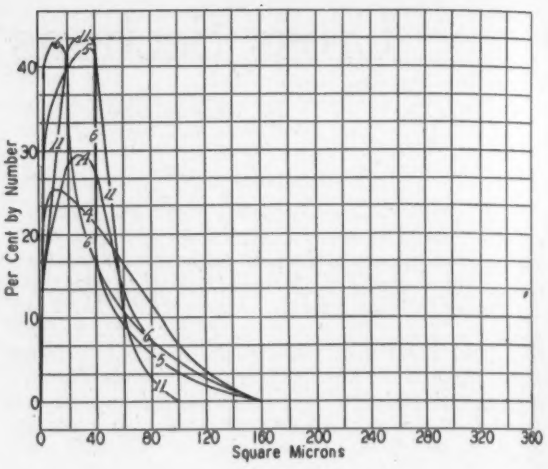

FIG. 4.
Frequency Distribution of the Cross Section Area of the Lumen

If the average number of fibers per gram of pulp were known, the data obtained for a given unit area could be translated into total surface area, gross and net volumes, volume of the lumen, volume of the air space between the fibers, and the total volume per gram of pulp.

In some previous work with softwood unbleached southern kraft, we have found that the average number of fibers per gram of pulp is about 5,500,000 with a probable error of ± 5,000. With this as a basis and using the weight factors of pulps as found by Graff (*1*), the number of fibers per gram of different pulps was estimated; these results are given in Table II.

TABLE II.—NUMBER OF FIBERS PER GRAM OF PULP

Rag	8,550,000
Softwood unbleached sulphite	9,250,000
Softwood bleached sulphite	9,880,000
Softwood unbleached western sulphite	6,800,000
Softwood bleached western sulphite	7,050,000
Softwood bleached alpha	12,850,000
Softwood unbleached kraft	9,525,000
Softwood unbleached southern kraft	5,500,000
Softwood bleached kraft	9,225,000

TABLE I

		Averages					Unit Area, 13776 mu²										
	Pulp	Length, mm.	Width, mu	Length/Width	Thickness, mu	Width/Thickness	Gross Area, mu²	Area of Lumen, mu²	Net Area, mu²	Roundness Factor	Perimeter, mu	No. of Fibers	Gross Area, %	Area of Lumen, %	Net Area, %	Air Space, %	Specific Surface, mu
1	S. W. unbl. jack pine kraft.....	0.502	28.4	17.65	12.70	2.23	269.0	57.8	211.5	44.75	106.5	40	78.00	16.70	61.30	22.00	4250
2	S. W. unbl. southern kraft.....	1.046	31.5	33.20	15.20	2.07	351.0	58.0	292.0	47.75	121.2	30	76.30	12.65	63.65	23.70	3640
3	S. W. Duracell...	0.995	27.2	36.60	10.70	2.54	218.5	42.4	176.0	41.50	98.6	49	78.00	15.10	62.90	22.00	4840
4	S. W. Cellate....	0.672	28.4	23.70	11.50	2.47	242.0	52.4	189.5	39.20	103.8	41	72.50	15.60	56.90	27.50	4150
5	European S. W. unbl kraft.....	0.464	30.4	18.25	11.50	2.65	239.0	38.9	200.0	39.40	109.0	39	67.70	11.00	56.70	32.30	4250
6	European S. W. bl. kraft.....	0.697	27.8	25.00	11.50	2.43	224.0	43.3	181.0	39.00	102.2	44	71.50	13.80	57.70	28.50	4500
7	S. W. unbl. Mitscherlich sulphite.	0.462	24.9	18.55	10.80	2.31	215.5	56.7	158.5	44.00	92.7	50	78.20	20.60	57.60	21.80	4540
8	S. W. bl. sulphite	0.894	27.1	33.00	9.75	2.77	205.0	36.0	168.5	38.60	96.0	51	76.00	13.30	62.70	24.00	4900
9	S. W. unbl. western sulphite.....	0.774	32.2	24.00	11.85	2.71	291.0	61.0	230.0	36.70	114.5	35	74.00	15.50	58.50	26.00	4000
10A	S. W. bl. western sulphite	1.080	31.9	33.80	12.65	2.53	304.0	60.3	240.5	38.40	115.5	33	73.00	14.50	58.50	27.00	3815
10B	S. W. bl. western sulphite	1.080	28.3	38.10	13.80	2.04	314.0	40.5	273.0	45.80	109.2	36	82.30	10.60	71.70	17.70	3940
11	S.W. regular alpha	0.858	23.1	36.90	9.10	2.54	153.0	25.2	129.0	37.90	84.0	57	63.50	9.95	53.55	36.50	4785
12	S.W. N.N. alpha	0.613	21.6	28.35	9.80	2.22	165.5	25.0	140.8	47.30	81.6	65	78.00	11.80	66.20	22.00	5300

Table III shows the resulting calculations per gram of pulp for the various samples, taking both the average fiber length and the number of fibers per gram of pulp into consideration.

The data in Table I suggest that there is a correlation between some of the factors. Therefore the simple correlations with the probable errors of some were calculated for all the factors, and the correlations, positive or negative, where the probable error was one fifth or less of the correlation, were selected. These data are shown in Table IV.

However, as some of the correlations in this table may have been accidental, due to the relatively small number of data for each factor (13), all the correlations were plotted (*see* Fig. 6). These curves show that most of the correlations, positive or negative, are unquestionable except perhaps for width/thickness ratio to percentage air space and roundness factor to percentage air space, which may be uncertain.

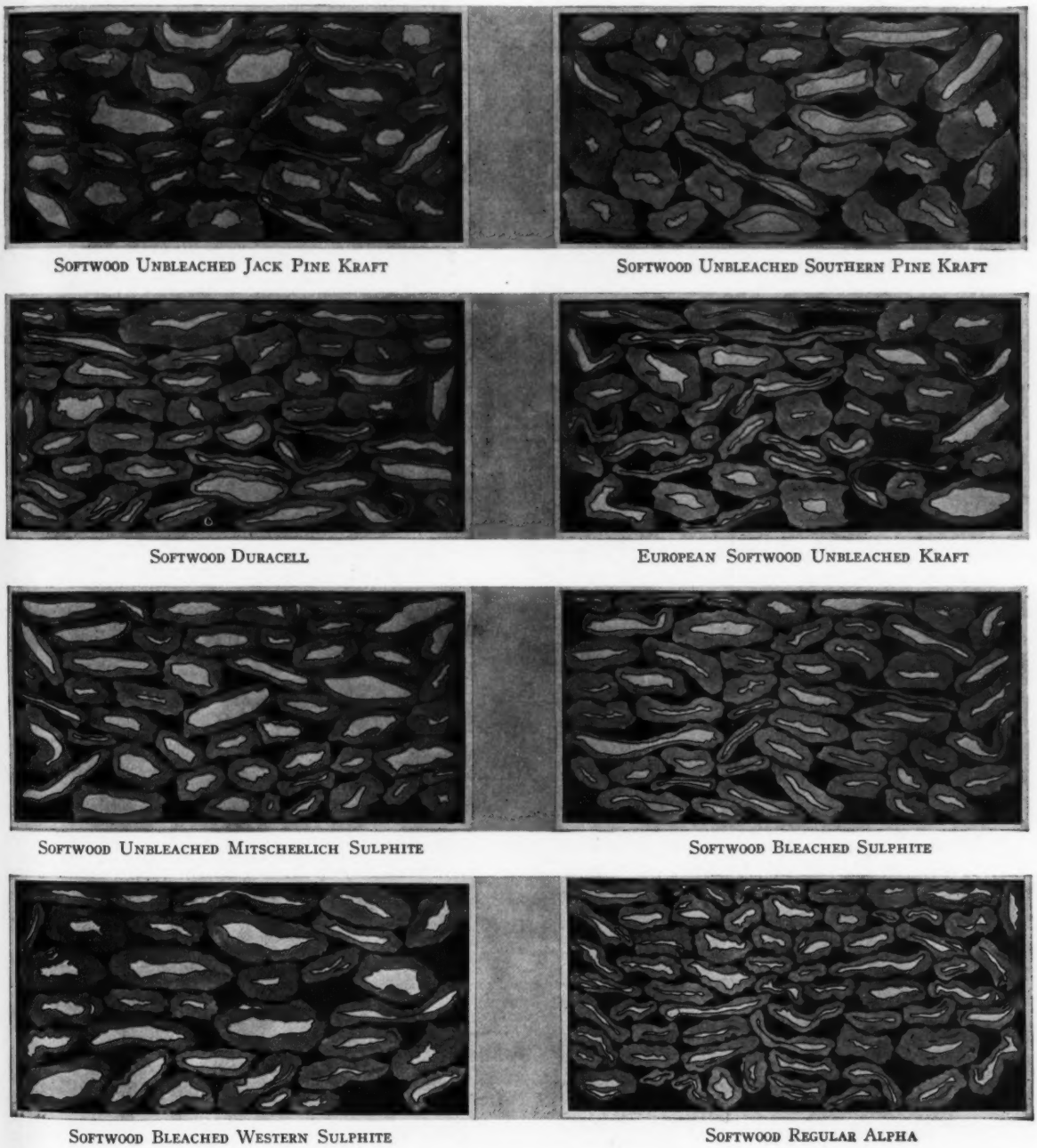
Softwood Unbleached Jack Pine Kraft
Softwood Unbleached Southern Pine Kraft
Softwood Duracell
European Softwood Unbleached Kraft
Softwood Unbleached Mitscherlich Sulphite
Softwood Bleached Sulphite
Softwood Bleached Western Sulphite
Softwood Regular Alpha
0 10 20 30 40 50 60 70 80 90 100 μ

FIG. 5.
Cross Sections of Pulp Fibers

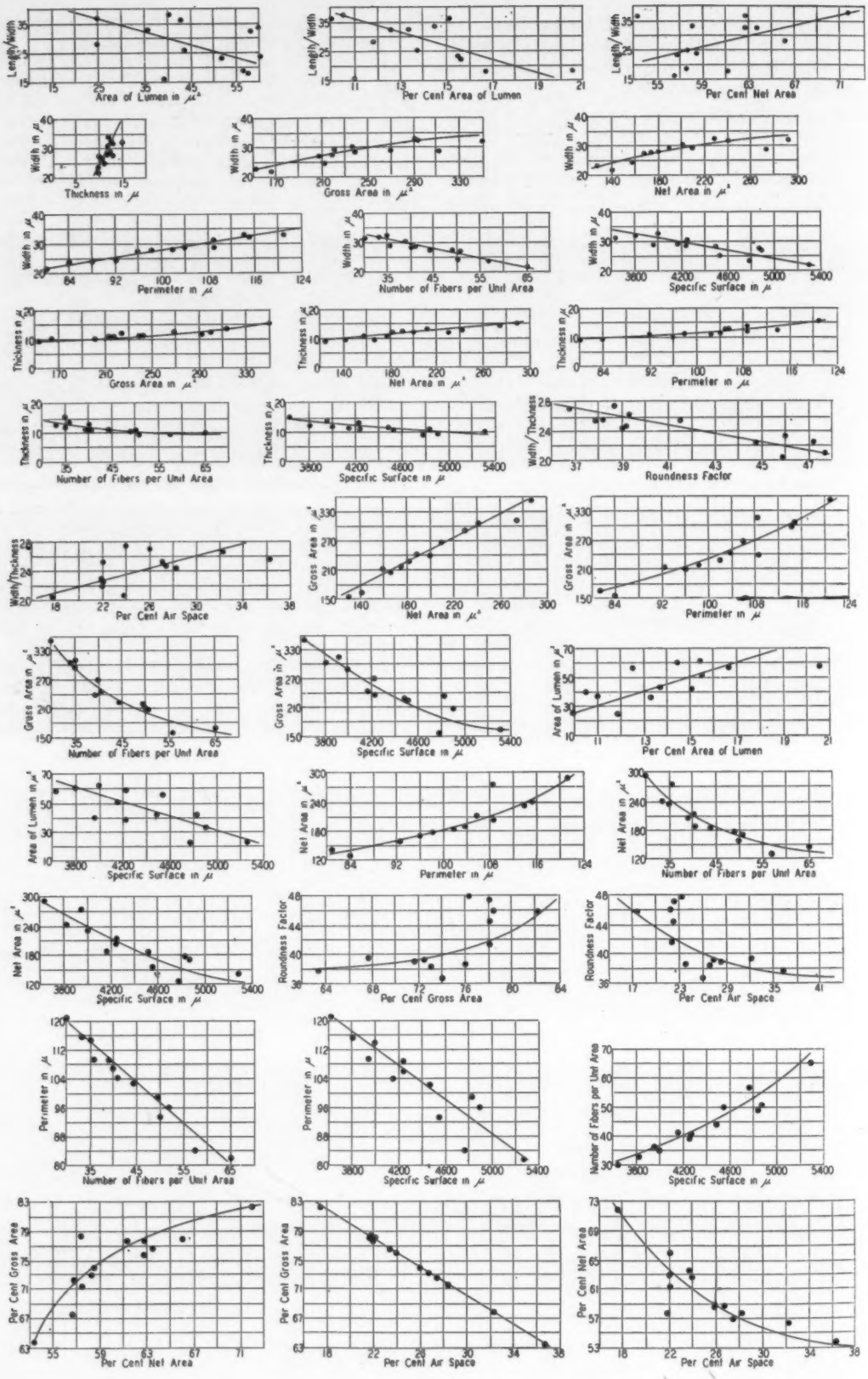

FIG. 6.

Various Correlations from Cross-Section Measurements

TABLE III

	Pulp	Averages: Length, mm.	Perimeter, mu	Gross Area, mu²	No. of Fibers	Total Surface Area, mu²	Factors Per Gram of Pulp: Volume of Fibers, cm.³	Volume of Lumen, cm.³	Net Volume, cm.³	Volume of Voids, cm.³	Total Air Space, cm.³	Total Volume, cm.³
1	S. W. unbl. jack pine kraft	0.502	106.5	269.0	9,525,000	0.5092	1.286	0.275	1.011	0.363	0.638	1.649
2	S. W. unbl. southern kraft	1.046	121.2	351.0	5,500,000	0.6973	2.046	0.339	1.707	0.635	0.974	2.681
3	S. W. Duracell	0.995	98.6	218.5	9,375,000	0.9194	2.038	0.394	1.644	0.574	0.968	2.512
4	S. W. Cellate	0.672	103.8	242.0	9,225,000	0.6435	1.500	0.323	1.177	0.569	0.892	2.069
5	European S. W. unbl. kraft	0.464	109.0	239.0	9,525,000	0.4817	1.056	0.172	0.884	0.504	0.676	1.560
6	European S. W. bl. kraft	0.697	102.2	224.0	9,225,000	0.6571	1.440	0.279	1.161	0.577	0.856	1.738
7	S. W. unbl. Mitscherlich sulphite	0.462	92.7	215.5	9,250,000	0.3962	0.921	0.243	0.678	0.257	0.500	1.178
8	S. W. bl. sulphite	0.894	96.0	205.0	9,880,000	0.8479	1.841	0.323	1.518	0.583	0.906	2.424
9	S. W. unbl. western sulphite	0.774	114.5	291.0	6,800,000	0.6026	1.532	0.322	1.210	0.541	0.863	2.073
10A	S. W. bl. western sulphite	1.080	115.5	304.0	7,050,000	0.8794	2.456	0.487	1.969	0.907	1.394	3.363
70B	S. W. bl. western sulphite	1.080	109.2	314.0	7,050,000	0.8414	2.391	0.308	2.083	0.515	0.823	2.906
11	S. W. regular alpha	0.858	84.0	153.0	12,850,000	0.9261	1.687	0.204	1.483	0.748	0.952	2.435
12	S. W. N. N. alpha	0.613	81.6	165.5	12,850,000	0.6428	1.304	0.198	1.106	0.370	0.568	1.674

It is of interest to note in Table IV that the average width of the fibers is very strongly correlated with average thickness, gross area of the cross section of the fibers, net area, perimeter, number of fibers per unit area, and the specific surface of the fibers. This is of importance because fiber widths can be determined easily by ordinary fiber dimension measurements and, when more cross-sectional data become available, it should be possible, knowing the width of the fibers in the pulp, to estimate the data for the other factors.

Conclusions

The cross-sectional areas and the direct measurements obtainable from the drawings of these areas are distinctly different for the individual types of pulp.

The cuts made from two mounts of the same pulp check comparatively well, as shown by the curves *A* and *B* in Figs. 2 and 3.

Purification or bleaching seems to change the roundness factor of the fibers, as shown by the curves of Pulps 5 and 6 in Fig. 3.

The number of fibers per unit area, the relative volume of the gross and net areas, the area of the lumen and the voids between the fibers of a given unit weight are distinctly different for the various types of pulp fibers, as shown in Tables I and III.

The fact that these differences are actually typical characteristics of the different pulps and not merely accidental is shown by the correlations in Table IV and Fig. 6.

The fact that the width of the fibers is the basis for some of the calculations and that this width is correlated with at least six of the other factors, as shown in Table IV and Fig. 6, and also the fact that

TABLE IV.—CORRELATIONS OF CROSS-SECTION DATA

		AVERAGES: Length/Width	Width, mu	Thickness, mu²	Width/Thickness	Gross Area, mu²	Area of Lumen, mu²	Net Area, mu²	Roundness Factor	Perimeter, mu	UNIT AREA: Number of Fibers	Gross Area, %	Area of Lumen, %	Net Area, %	Air Space, %	Specific Surface, mu
AVERAGES	Length/Width						−0.900 ±0.083					+0.755 ±0.161	−0.900 ±0.083	+0.900 ±0.083		
	Width, mu			+0.890 ±0.105		+1.000 ±0.000		+1.000 ±0.000		+1.000 ±0.000	−0.970 ±0.032					−1.000 ±0.000
	Thickness, mu		+0.890 ±0.105			+0.890 ±0.105		+0.890 ±0.105		+0.890 0.105	−0.970 ±0.032					−0.890 ±0.105
	Width/Thickness								−0.755 ±0.161						+0.970 ±0.032	
	Gross Area, mu²		+1.000 ±0.000	+0.890 ±0.105				+1.000 ±0.000		+1.000 ±0.000	−0.970 ±0.032					−1.000 ±0.000
	Area of Lumen, mu²	−0.900 ±0.083											+0.890 ±0.105			−0.890 ±0.105
	Net Area, mu²		+1.000 ±0.000	+0.890 ±0.105		+1.000 ±0.000				+1.000 ±0.000	−0.970 ±0.032					−1.000 ±0.000
	Roundness Factor				−0.755 ±0.161							+0.890 ±0.105			−0.970 ±0.032	
	Perimeter, mu		+1.000 ±0.000	+0.890 ±0.105		+1.000 ±0.000		+1.000 ±0.000			−0.970 ±0.032					−1.000 ±0.000
UNIT AREA	Number of Fibers		−0.970 ±0.032	−0.970 ±0.032		−0.970 ±0.032		−0.970 ±0.032		−0.970 ±0.032						+0.970 ±0.032
	Gross Area, %	+0.755 ±0.161							+0.890 ±0.105					+0.970 ±0.032	−0.970 ±0.032	
	Area of Lumen, %	−0.900 ±0.083					+0.890 ±0.105									
	Net Area, %	+0.900 ±0.080										+0.970 ±0.032			−0.970 ±0.032	
	Air Space, %				+0.970 ±0.032				−0.970 ±0.032			−0.970 ±0.032		−0.970 ±0.032		
	Specific Surface, mu		−1.000 ±0.000	−0.890 ±0.105		−1.000 ±0.000	−0.890 ±0.105	−1.000 ±0.000		−1.000 ±0.000	+0.970 ±0.032					

the width can be obtained by fiber dimension determinations suggest that, when more data have been collected on cross-sectional calculations, some of these data may then be predicted directly from the width measurements.

The large differences in total surface areas, number of fibers, gross and net areas, and areas of lumen and voids per unit weight of the various pulps suggest that these factors also should be related to freeness, beating, sizing, dyeing, retention of fillers, and felting characteristics of pulps, and surface texture of papers made from the pulps. Having determined these relationships, we should arrive at a better understanding of these factors.

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Some Observations on the Materials Used in Packaging Frozen Foods*

By William Rabak[1]

Abstract

Experimental data show that the amount of moisture lost from frozen foods depends upon the resistance to water vapor permeability of the wrapping or lining materials, and upon the efficiency of the sealing.

The proper packaging of frozen fruits and vegetables for consumer use is an important factor in the frozen pack industry at this time because the industry recognizes that incorrect packaging may be responsible for serious deterioration in storage. The importance of gastight, moistureproof containers for the prevention of deterioration through dehydration, contamination, and oxidation is well recognized by the industry.

The type of container to be selected for a specific commodity depends somewhat upon the nature of the product and the manner of freezing. Tin or glass containers are advantageous because of their resistance to the penetration of water vapor or water, and because the sealing operation is relatively simple. On the other hand, paperboard containers offer definite commercial advantages. For this reason, the use of paperboard cartons for packaging frozen fruits and vegetables is now quite widespread. Paperboard cartons supply a package that is distinctive for frozen foods because of its light weight, convenient shape, and ability to stand rough usage at low temperatures.

The use of the various types of paperboard containers and wrappers has presented one major problem to the frozen pack industry, i.e., the prevention of dehydratoin of frozen foods during storage with the accompanying loss of quality. The successful packaging of frozen fruits and vegetables in cartons is a highly specialized operation which calls for careful selection of materials properly suited for the purpose. In many cases the use of untried carton and wrapping materials has resulted in the production and use of containers which are entirely unsuited for this purpose. The use of non- or semimoistureproof containers has frequently resulted in the deterioration of a high class product in storage through loss of moisture. Losses of this kind can be avoided by the careful selection of carton stock, lining, and wrapping materials.

The difficulty can in most cases be traced to the packers who have failed to emphasize the highly specialized requirements to the manufacturers of carton and wrapping materials, or failure on the part of the manufacturers to fully appreciate the needs of their clients. This lack of understanding sometimes results in supplying the packer with ordinary so-called moistureproof materials which the manufacturer has found to be satisfactory for use in packaging other types of products requiring protection against loss of moisture. The conditions surrounding the packaging of frozen fruits and vegetables are unique in that the products, the handling, and the packaging are a strict departure from the ordinary. Because of the new set of conditions which must be met, practical cooperative research is necessary between the packer of frozen fruits and vegetables and the package supplier.

In an attempt to assist the packers of frozen fruits and vegetables in the solution of this problem, a series of experiments were undertaken during 1938 in the Frozen Pack Laboratory, U. S. Department of Agriculture at Seattle, Washington. The work was done in collaboration with the research committee of the Northwest Frozen Foods Association who cooperated in securing the materials included in the survey. These experiments apparently were conducted simultaneously with some by Dubois and Tressler *(1)* who reported the results of similar examinations of moistureproof wrapping materials. The experiments were undertaken in a spirit of helpfulness with the ultimate hope that the results would stimulate an interest in the development of more suitable types of containers, rather than with the idea of making a complete or exhaustive study. Consequently, the information given here is submitted for its suggestive value rather than in expectation that the results will serve as a definite pattern for container manufacturing.

The primary object of this work was to ascertain the extent of the variation of vaporproofness which exists between various types of carton stocks and wrapping materials in an attempt to emphasize the necessity of careful selection to the packer. The work included a series of controlled experiments designed to test the vaporproofness of the various packaging and wrapping materials, and a practical experiment to study the efficiency under commercial storage conditions of various types and combinations of cartons and wrapping materials in common use.

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Penetration of Moisture

The results of the experimental work on carton materials indicated the existance of a considerable range of water vapor resistance. In this work, a study was made of the amount of moisture or vapor which would penetrate carton boards at 70 deg. F. and 0 deg. F. The ability of each type of board to resist the penetration of moisture was measured by the increase in weight of anhydrous calcium chloride contained in specially designed containers which exposed a known surface area to an atmosphere of 50% relative humidity at 70 deg. F. for a six-day period. These containers, which were spun from heavy gage aluminum, were 13.4 cm. in diameter, 6.5 cm. deep, and constructed with a flat shoulder 1.8 cm. wide. Heavy rubber rings were cut to fit the shoulders and the samples under examination were placed between the rings and made tight by means of steel C clamps. Low form, ground-glass stoppered weighing bottles containing 50 grams of anhydrous calcium chloride were employed for measuring the amount of moisture penetration. At the lower temperatures the exact humidities were not known, but represented the atmospheres encountered under average commercial storage conditions. The exposures to the various storage conditions were made in specially designed cabinets, in which the air was kept in constant motion by means of circulating pumps. The results were calculated to the average penetration in grams of moisture per 1000 sq. cm. per day.

The results of this work indicated that at 70 deg. F. considerable difference in vaporproofness exists between the impregnated paperboards and the coated paperboards. For example, six paperboards permitted an average penetration of 0.78 grams of moisture per 1000 sq. cm. per day, as compared with 2.3 grams in the case of the impregnated paperboards. However, as frozen foods cannot be stored at 70 deg. F., the comparison is not as significant as the figures revealed by the study at 0 deg. F. At zero, the average penetration through the coated boards was 0.15 grams per 1000 sq. cm. as compared with 0.24 grams in the case of the impregnated boards. These figures show that, at the usual low temperature storage, the rate of moisture exchange is considerably retarded and for this reason only the results obtained at storage temperatures may be considered as having practical significance. It therefore appears that the important factors to consider in selecting carton stocks are appearance, rigidity, a reasonable vaporproofness and an ability to resist absorption of extraneous odors.

The character of the water repellent employed for impregnation or coating should be such that elasticity is retained at low temperatures in order to prevent crystallization and the formation of minute fissures upon prolonged storage at low temperatures. While none of the coated or impregnated boards included in this study were found to show any tendency to crystallize or crack at storage temperatures down to 0 deg. F., this is an important point which should be borne in mind when selecting carton stock for frozen food materials.

Coated Paperboards

While the coated paperboards are somewhat more efficient than the others, a thick coating of waterproofing material is not necessary. Heavy coatings may be objectionable because of the tendency to flake off at low temperatures or the possibility of being scraped off mechanically during handling or storage which, in some cases, might result in contamination of the commodity. It is therefore deemed advisable to critically examine or compare the behavior of coated carton stocks while held at low temperatures, to observe any tendency of the coating to harden and flake.

In some cases there appears to be some advantage in the use of carton material which shows a high resistance to the absorption of water. This is true when the packer desires to eliminate the use of moistureproof bags or liners and pack the product in direct contact with the carton.

For this reason, experiments were included to measure the relative water-resisting qualities of several types of carton stock recommended for general use in frozen pack. These tests measured the average loss of water in direct contact with the material at 70 deg. F. over a six-day period.

Under these conditions the coated type of paperboard was found to be superior to the impregnated carton stock. A typical coated paperboard (0.020 inch) was found to permit the passage of 6.2 grams of water per 1000 sq. in. per day at 70 deg. F. An impregnated paperboard of the same gage permitted the passage of 38.2 grams of water. Ordinary untreated cardboard of approximately the same thickness, which was used as a control, allowed the passage of 110.2 grams of water. These results emphasize the importance of selection of suitable carton materials by processors who desire to pack without the use of liners.

In view of the fact that a large percentage of the packers in the Pacific northwest prefer to wrap the retail packages with an outer wrapper as an extra precaution against dehydration, it was thought important that a scientific study be made of the water vapor permeabilities of the most widely used types of wrapping materials.

Description of Study

The method of examination was that described by Tressler and Evers *(2)* which consists of the measurement of the amount of water vapor losses permitted by the various materials when interposed between an atmosphere of high relative humidity on one side and a 50% relative humidity on the other. The extent of the penetration was obtained by measuring the losses of moisture from the saturated atmosphere to the circulating atmosphere of 50% relative humidity at 70 deg. F. over a six-day period of exposure. At 15 deg. F. and 0 deg. F. the atmospheric humidities were those existing under average commercial conditions, the exact moisture content of the air being unknown. In these experiments nonvaporproof 30-pound untreated vegetable parchment was used as a control. The study included various types of moistureproof paper, the moistureproof viscose sheets, laminated rubber compound sheet, and ethyl cellulose treated paper.

An additional feature was incorporated in these experiments which consisted of the measurement of the effect of "creasing" upon water vapor penetration. This was included to obtain experimental proof as to whether or not the wrapping procedure, which produces sharp folds, affected the vaporproofness of the wrapping material. The water vapor penetration experiments on wrapping materials were conducted

at 70, 15 and 0 deg. F. Twenty-seven materials were included in the study and only general conclusions are reported here. The results obtained were of definite value in evaluating the efficiency of the various types of wrapping materials which are recommended for frozen pack use.

The control paper of untreated vegetable parchment was found to permit the penetration of 33.6 grams of moisture per 1000 sq. cm. per day at 70 deg. F. At 15 deg. F. this paper permitted the loss 2.0 grams, and at 0 deg. F., of 0.44 grams. Generally speaking, the paraffin or wax treated papers were found to be quite efficient in vapor retention. Heavily waxed paper such as employed by the frozen food industry was found to permit the penetration of 0.20 grams of vapor per 1000 sq. cm. per day at 70 deg. F. A 30-pound stock vegetable parchment paper, waxed on both sides, did not permit the passage of any weighable amount of watervapor under the same conditions. At lower temperatures, i.e., 15 and 0 deg. F., the amount of penetration of the double waxed papers was negligible and, in some cases nil, over a six-day exposure period.

However, creasing was found to materially interfere with the efficiency of the waxed papers. Thirty-two cm. of lineal creasing on an exposed area of 50.26 sq. cm., generally increased the moisture penetration quite considerably. The waxed parchment, which permitted the loss of weighable moisture over a six-day exposure period at 70 deg. F., upon creasing permitted the loss of 0.24 grams. The ordinary wax paper which permitted the loss of 0.20 grams plain, permitted the loss of 0.48 grams after creasing. As would be expected, at 15 and 0 deg. F. the moisture losses through the creased papers were only a fractional part of those at 70 deg. F.

The moistureproof viscose sheets recommended for frozen pack were found to be very efficient at all temperatures. In addition, the efficiency of these sheets was not affected by creasing. The laminated rubber compound sheets were likewise found to be effective in inhibiting the passage of watervapor at all temperatures, whether plain or creased. Because of the ability to stand rough handling at low temperatures, moistureproof viscose and rubber compound sheets were deemed to be superior to the average treated paper material.

In order to compare in a practical way the efficiency of various types of packages and wrapping materials, a number of practical experiments were conducted under commercial frozen pack storage conditions. The water vapor deficits encountered in the low temperature storage rooms utilized for these experiments were not definitely known. However, the temperature fluctuation, which according to Finnegan *(3)* is responsible for considerable desiccation in storage, was at a minimum (+ or —5 deg. F.) and all the packages were subjected to identical conditions insuring comparative results in all cases.

Loose frozen peas were selected as the experimental material because of the ease of handling and availability. In these "loss in weight in storage experiments", most of the 12-ounce types of packages in common use were included, wrapped and lined with various combinations of liners and wrapping materials.

The packages were filled and sealed under average commercial frozen pack conditions, weighed and held in commercial storage at 15 and 0 deg. F. for a period of nine months. Weighings were made periodically in the rooms in which they were stored. All packages were placed on edge, allowing several inches of space between packages to permit free circulation of air. The carton material in all cases was of the coated paperboard stock and all packages were formed by hand previous to the packing operation. The types of packages included were as follows:

1. Hinged, "tuck in 3 sides" lid, top opening
2. Hinged, "tuck in 1 side" lid, top opening
3. End opening, self contained bag inside
4. "Tuck in" end opening
5. Telescope tray type.

The results of this experiment indicated that the efficiency of the packages in preventing watervapor loss in storage depended largely upon the relative vaporproofness of the liner or wrapper and the efficiency of the seal. Ordinary vaporproof paper heavily waxed on both sides, vaporproof viscose sheets, and rubber compound sheets were all found to be reliably efficient in preventing the loss of moisture or vapor during a nine-month storage period at 15 and 0 deg. F. Plain viscose lining material (nonmoistureproof) was not found to be effective in preventing the loss of weight under these conditions. The lowest weight losses were observed in those cases where the most efficient moistureproof wrappers had been employed. Citing a typical instance, one type of efficient liner and wrapper (double wrapped) permitted only a 0.1% loss after nine months of commercial storage at 0 deg. F. Generally speaking, the packages which were either wrapped or lined with moistureproof material and carefully sealed, were found to permit less than 0.5% loss during a nine-month storage period at 0 deg. F. At 15 deg. F. the same character of lining and wrapping permitted the loss of 0.75 to 1.0% of moisture. One "tuck in" end opening package lined with *non-moistureproof* viscose sheet, lost 9.7% of its weight at 0 deg. F. and 14.8% at 15 deg. F. after nine months of storage. Those packages which were wrapped in material showing inefficiency after creasing showed a greater weight loss than did those which were wrapped in crease-resistance material.

The experimental data show that the amount of moisture lost from frozen foods depends upon the degree of water vapor resistance of the wrapping or lining materials, and upon the efficiency of the sealing. This conclusion is based not only on an accurate knowledge of the relative vaporproofness of packaging materials, but also upon practical experiments involving the actual storage of frozen peas under commercial storage conditions. The results attained the object sought in that they strongly emphasize the importance of the careful selection of efficient packaging and wrapping materials for use in packaging frozen fruits and vegetables.

Additional Information

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Effect of Subliners on Lined Board Brightness*

By W. R. Willets[1], R. T. Bingham [2], and L. H. Eriksen[3]

Abstract

The brightness and color of a lined board is experimentally shown to be dependent on the topliner characteristics, and on the characteristics of the underlying base. Brightness can be improved by applying a subliner (underliner) which will mask the dark color of the back, and, therefore, give a brighter base for the application of the topliner. The appearance of such a board will be affected by the opacity, brightness and color of both the sub- and topliner, but is more dependent on the characteristics of the topliner than of the subliner. Proper use of titanium dioxide in the topliner makes it possible to mask any base and secure good ultimate color and brightness.

Previous publications have indicated some of the factors affecting the brightness of a lined board (*1, 2*), and among the conclusions noted were that the brightness of a lined board was dependent on the opacity and brightness of the topliner sheet, and also on the brightness and color of the back.

It is obvious that if a subliner (underliner) is used, the picture will be changed somewhat and the statement has already been made: "Naturally, the use of subliners of better brightness and color than the underlying filler plies will aid the brightness of the final lined board" *(2)*.

The work reported herein notes the effect of using subliners on boards made with topliners of constant weight whose opacity and brightness were varied by the addition of titanium dioxide.

Procedure

The general procedure for this work has already been described and so will not be repeated (*1*).

The topliner stock consisted of bleached sulphite pulp, lightly beaten (63 deg. Schopper Riegler for Set 1 and 60 deg. Schopper Riegler for Set 2).

The subliner stock for Set 1 was made of the same material as the topliner stock, while for Set 2 a mixture of groundwood (about 65%) and unbleached sulphite (about 35%) was used, to simulate a "manila" subliner.

In all cases the back (filler) stock was made from old newspapers disintegrated using a high speed stirrer.

Each set comprised a series of sheets, as follows: unlined boards (backs); three different weights of subliner sheets; boards made by lining the backs with these three different weights of subliner sheets; topliner sheets of constant weight unpigmented and pigmented with titanium dioxide; boards made by applying these topliners to bases made with, and without, the subliners.

The opacity and brightness of the subliner and topliner sheets were determined using a Bausch and Lomb opacimeter, and color was measured on a Hunter reflectometer (*3*) using three filters (red, blue and green), while the brightness and color of the boards were similarly measured. The basis weight and caliper of the liner sheets, and the titanium dioxide content of the topliner sheets, were also determined. While the figures for brightness and color are probably not absolute they are relative and comparable and the numerical values confirm visual examination.

Results

Details of the test data are given in the appendices.

Appendix 1 shows the characteristics of the topliners prepared with different amounts of titanium dioxide. As might be expected, the opacity and brightness of these sheets were increased with pigmentation. The color of the topliner sheets was distinctly on the yellow side, as indicated by the reflectometer readings, but this yellowness tended to decrease as pigmentation was raised.

As has been shown (*1*), such an increase in opacity and brightness will result in improved brightness of the lined board; and this is shown in Appendix 2 which gives data for boards lined with topliners only. Because of the lower brightness and more neutral tone of the back, the color of these was also more neutral, the yellowness of the topliner sheets being offset by the show-through of the back.

Data for the subliner sheets are given in Appendix 3. Here it will be noted that the opacity increased with increasing weight. The color of the subliner sheets for Set 2 (groundwood-sulphite) was somewhat more yellow than for Set 1 (bleached sulphite).

Since boards made with these subliner sheets alone correspond to a single lined board, as indicated previously, the brightness of the board was dependent on the opacity (as governed by the weight) of the subliner (*1*). Because of the higher opacity and the absence of pigment, the boards made with the subliner sheets alone assumed more of the yellow tone of the subliner sheets. Data demonstrating this are given in Appendix 4.

Appendix 5 contains the data for the boards made with both subliners and topliners. It was indicated that for any given topliner condition, the brightness of the board was largely dependent on the weight of the subliner—i.e. boards made with a heavy subliner and any given topliner were brighter than boards made with a lighter weight subliner. Also, it may be noted that, because of the smaller differences in color and brightness between the subliner and topliner sheets than between the topliner sheets and the

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back, the color of the boards more nearly assumed the color tone of the topliner.

Brightness

In a board made of a back (filler), a subliner and a topliner, all three constituents affect its ultimate color and brightness, especially if the liners are deficient in opacity.

If the back is covered with the topliner only, the brightness will be determined by the opacity and brightness of the topliner sheet, as already reported (*1*). This is shown in the lower curves of Figs. 1 and 2, in which the opacity and brightness of the liner were increased by the use of titanium dioxide, with a resultant increase in board brightness.

The use of a subliner alone will also increase the brightness of the board depending on its opacity and brightness, but in this case the effect is caused by the increased weight; the board made with the heavier (and, therefore, more opaque) subliners having a better brightness than those made with the lighter weight sheets. The effect of liner weight on board brightness has already been noted (*1*) and is indicated in Figs. 1 and 2.

If the board comprises both sub- and topliners, then its brightness will be affected by the characteristics of both. Once the subliner is applied, the brightness of the base is raised; and a condition now exists which is in effect analogous to a case, where a topliner is applied to an underlying back having a higher brightness. It has already been shown that the brightness of a lined board is dependent not only on the opacity and brightness of the liner but also on the brightness of the underlying back; and that if the brightness and opacity of the liner are constant, an increase in the brightness of the back will increase the brightness of the board (*2*).

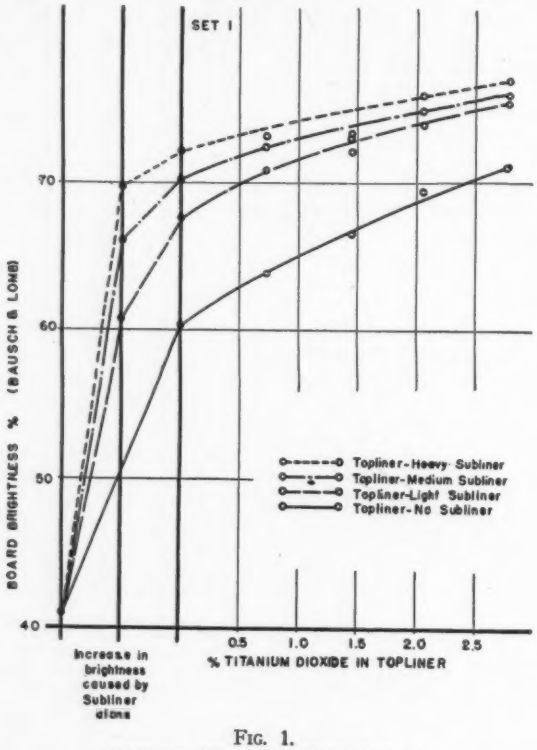

FIG. 1.
Brightness (Bleached Sulphite Subliner)

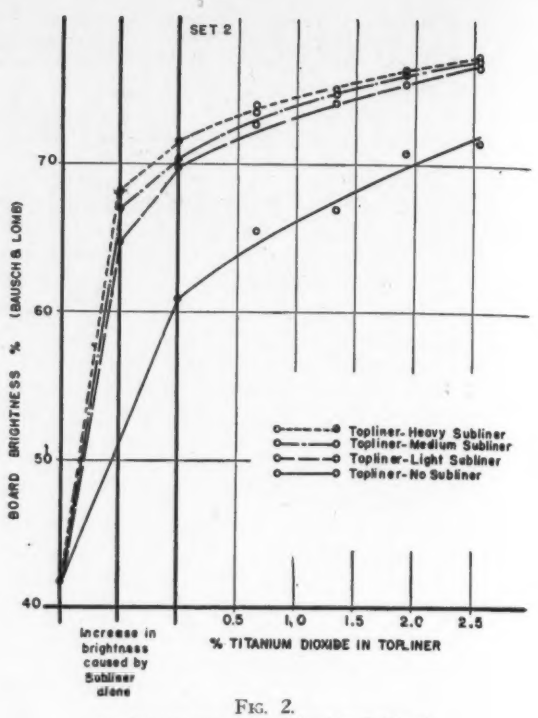

FIG. 2.
Brightness (Groundwood-Sulphite Subliner)

Since the stock which was used for the subliners was unpigmented, the brightness of the boards with only the subliner applied was dependent on the opacity or covering power derived from an increase in weight and the characteristics of the stock. The addition of an unpigmented topliner increased the brightness by a further masking of the back; especially in the cases where light subliners were used, as well as covering the subliner to some extent (this masking being dependent on the characteristics of the topliner). In the case of Set 1 the increase resulted from an increase in weight as both sub- and topliners were of the same stock, while Set 2 was the result of an increase in weight and different subliner stock characteristics.

In both cases the addition of a topliner to a sublined board resulted in higher brightness, the extent of the increase being dependent on the characteristics of the liner stocks. It will be noted that regardless of the underlying base, pigmentation of the topliner stock resulted in definite increases in board brightness.

It is interesting to note that the presence of 1.5% titanium dioxide in the topliner of the board with the light weight subliner in Set 1 (Fig. 1) resulted in a brightness equal to the board with an unpigmented topliner and a subliner approximately 40 pounds heavier in weight. In Set 2 the same condition was reached with but 0.5% titanium dioxide in the topliner. Many similar conclusions may be drawn from an examination of the curves. Although Figs. 1 and 2 are based on the data for only limited sets of conditions, similar relationships are indicated for various types of backs, subliners, and topliners.

Color

It might seem that the board made without a subliner having a topliner containing about 1.5%

titanium dioxide would have a similar appearance to one of equivalent brightness made with a light subliner and an unpigmented topliner (Fig. 1). However, in addition to brightness, the appearance of the board is dependent on color which is influenced by both the topliner and the underlying back or subliner.

The curves of Fig. 3 show the detailed color data of Appendix 5, but they do not represent a true spectral analysis of the color data as they are only of a graphic nature to show the color characteristics. The relationship of the readings made with the blue, green, and red filters indicates yellowness—e.g.,

$$\text{Comparative Yellowness} = \frac{\%\ \text{Red} - \%\ \text{Blue}}{\%\ \text{Green}} \times 100$$

(The curves of Fig. 3 are for the heavy weight subliners and only show 0.0 and 4.0% pigment addition to the topliners. However, similar curves could be plotted throughout for the three weights of subliners and for the various pigmentations of topliners.)

The ultimate color of the board is dependent on the combination of topliner and base, or on the topliner itself providing that it is sufficiently opaque so as to mask the base completely.

It will be noted that in both sets the brightness of the backs was low but fairly neutral in color, as indictated by the relatively straight line obtained for the color readings. Because of its relatively low opacity, when the unpigmented sheet used for the topliner was superimposed on the back, the color of the back showed through and tended to neutralize the yellow tone. The addition of pigment to the topliner, although raising brightness appreciably, did not materially change the color of the board when topliners alone were used, as they did not have suffiicent masking effect.

However, when a subliner alone was used, this liner masked the color of the back to an extent depending on its opacity, thus minimizing the influence of the back on the color of the board. The board in Set 1 was more nearly neutral in color than that of Set 2 which can be accounted for by the greater masking effect and yellower color of the subliner used in the second set. The board lined with the heavy weight subliner only in Set 2 had almost the same color characteristics as the subliner sheets themselves.

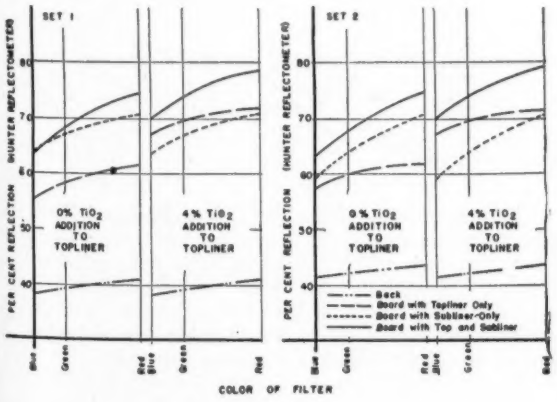

FIG. 3.
Color Characteristics

In both cases the boards made with only the 4.0% pigmented topliner exceeded in brightness the boards made with only the heavier weight unpigmented subliners.

When an unpigmented topliner was added to the sublined base, the board more nearly approached the color of the topliner since the difference in color between top- and subliners was but relatively slight. Because of the yellower color of the subliners of Set 2, the addition of the topliner resulted in a more yellow board than the corresponding board of Set 1.

The addition of titanium dioxide to the topliner stock increased its opacity and brightness. As the opacity increased, the effect of the base (whether back or subliner) on the color of the board decreased, and the board color approached the characteristics of the topliner sheets which were practically the same for both sets. This, which was confirmed by visual examination, would indicate that the brightness and color of a lined board made with a subliner are more dependent on the characteristics of the topliner than of the subliner. The use of titanium dioxide naturally increased this tendency because of its opacifying effect, and also resulted in a board more nearly neutral in color as evidenced by the slight flattening of the color curves. It would appear, therefore, that by the use of titanium dioxide in the topliner, a board having suitable color and brightness can be made regardless of the subliner used. This can be accomplished even with light weight topliners, because the opacity—i.e., the covering power—and brightness are readily obtainable by proper pigmentation.

Furthermore, it is indicated that it is possible by the use of a pigmented topliner to make a board having better brightness and color without the use of a subliner than it is by using a subliner and an unpigmented topliner of the same weight as the pigmented one. However, it is also apparent that the desired color of the board must be taken into consideration and the most suitable combination selected to meet requirements.

Conclusions

The brightness of a lined board is dependent on the opacity and brightness of the topliner, and the brightness of the underlying base.

If the brightness and opacity of the topliner are constant, an increase in the brightness of the underlying base, such as is effected by applying a subliner, will increase the brightness of the board.

If the brightness of the underlying base is constant, an increase in the opacity and brightness of the topliner will increase the brightness of the board.

If a board is made with a subliner and topliner, its brightness is increased, dependent on the opacity and brightness of both the subliner and the topliner.

The brightness and color of a board made with a subliner are more dependent on the characteristics of the topliner than of the subliner.

If titanium dioxide is used in the topliner, it is possible to cover a subliner and secure a good ultimate color and brightness regardless of the kind of subliner stock used.

If titanium dioxide is used in the topliner, it is possible to produce a board having better brightness and color without the use of a subliner, than by using a subliner and an unpigmented topliner.

The selection of liners for a board and the pigmentation of the topliner are dependent on the

brightness and color specifically required.

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APPENDIX 1.—TOP LINER DATA

	Titanium Dioxide Added %	Titanium Dioxide Content %	Caliper in./1000	Basis wgt., (25x38-500) lb.	Bausch & Lomb Opacity %	Bausch & Lomb Brightness %	Hunter Reflectometer Red %	Hunter Reflectometer Blue %	Hunter Reflectometer Green %
Set 1	0	0	2.9	39.4	64.5	73.2	76.1	61.0	67.8
	1	0.72	2.9	39.6	70.3	77.0	79.5	66.0	72.2
	2	1.43	2.9	38.9	74.5	77.0	79.9	66.8	72.8
	3	2.05	2.6	38.9	76.2	80.0	82.0	69.7	75.7
	4	2.77	2.7	39.2	79.4	81.4	83.7	72.4	78.0
Set 2	0	0	3.0	37.9	64.7	73.6	74.8	59.5	66.7
	1	0.66	2.9	39.5	70.5	77.8	79.3	66.7	73.0
	2	1.32	3.1	39.4	75.1	78.9	80.5	68.7	74.2
	3	1.92	3.1	41.0	79.2	79.6	80.8	69.5	74.8
	4	2.56	3.1	39.8	80.1	80.8	82.2	71.7	76.8

APPENDIX 2.—DATA FOR BOARDS LINED WITH BLEACHED SULPHITE TOP LINERS ONLY

	Titanium Dioxide Added to Liner %	Titanium Dioxide In Liner %	Bausch & Lomb Brightness %	Hunter Reflectometer Red %	Hunter Reflectometer Blue %	Hunter Reflectometer Green %
Set 1	0	0	60.4	61.5	55.2	58.3
	1	0.72	63.9	65.2	59.5	71.9
	2	1.43	66.6	66.8	61.2	64.2
	3	2.05	69.5	69.4	64.5	67.2
	4	2.77	71.2	72.0	67.0	70.0
Set 2	0	0	61.1	61.8	57.5	60.0
	1	0.66	65.5	65.5	61.7	64.2
	2	1.32	67.1	66.8	62.5	65.0
	3	1.92	70.7	69.6	65.3	68.0
	4	2.56	71.6	71.5	67.2	70.0

APPENDIX 3.—SUBLINER DATA

	Caliper in./1000	Basis wgt., (25x38-500) lb.	Bausch & Lomb Opacity %	Bausch & Lomb Brightness %	Hunter Reflectometer Red %	Hunter Reflectometer Blue %	Hunter Reflectometer Green %
Bleached Sulphite, Set 1							
Heavy weight	5.0	77.4	80.6	75.8	79.5	64.8	72.0
Medium weight	4.2	58.5	75.3	76.8	79.0	64.8	71.5
Light weight	3.4	38.8	65.7	75.0	78.0	64.0	70.2

APPENDIX 3.—SUBLINER DATA (Continued)

	Caliper in./1000	Basis wgt., (25x38-500) lb.	Bausch & Lomb Opacity %	Bausch & Lomb Brightness %	Hunter Reflectometer Red %	Hunter Reflectometer Blue %	Hunter Reflectometer Green %
Groundwood-Sulphite, Set 2							
Heavy weight	6.3	75.9	97.3	69.0	71.8	57.8	63.3
Medium weight	4.8	56.5	92.8	69.1	71.8	57.8	63.3
Light weight	3.6	37.1	82.6	69.0	72.0	58.2	63.8

APPENDIX 4.—DATA FOR BOARDS LINED WITH SUBLINERS ONLY

	Bausch & Lomb Brightness %	Hunter Reflectometer Red %	Hunter Reflectometer Blue %	Hunter Reflectometer Green %
Set 1				
Back	41.0	41.4	38.5	39.4
Bleached Sulphite Subliner				
Heavy weight	69.8	71.0	63.5	67.3
Medium weight	66.2	67.5	60.8	64.2
Light weight	60.7	62.3	56.8	59.6
Set 2				
Back	41.8	43.6	41.5	42.3
Groundwood-Sulphite				
Heavy weight	68.3	71.0	59.2	64.2
Medium weight	67.0	69.9	59.2	60.0
Light weight	64.7	65.5	57.5	61.3

APPENDIX 5.—DATA FOR BOARDS LINED WITH SUB AND TOP LINERS

Top Liner: Titanium Dioxide Added %	Top Liner: Titanium Dioxide Content %	Subliner	Bausch & Lomb Brightness %	Hunter Reflectometer Red %	Hunter Reflectometer Blue %	Hunter Reflectometer Green %
Set 1—Bleached Sulphite Subliner						
0	0	Heavy	72.2	74.7	62.8	68.3
1	0.72	Heavy	73.2	76.3	65.3	71.9
2	1.43	Heavy	73.2	75.0	65.0	70.2
3	2.05	Heavy	76.0	78.2	69.0	73.7
4	2.77	Heavy	77.0	79.0	69.9	74.3
0	0	Medium	70.3	72.3	61.2	66.5
1	0.72	Medium	72.5	75.0	65.0	70.0
2	1.43	Medium	73.1	74.7	65.2	69.8
3	2.05	Medium	75.0	76.2	67.5	72.0
4	2.77	Medium	76.0	78.0	69.2	73.5
0	0	Light	67.7	69.7	58.6	63.8
1	0.72	Light	70.9	73.0	64.0	68.5
2	1.43	Light	72.1	73.7	65.0	69.0
3	2.05	Light	74.1	74.8	66.8	71.0
4	2.77	Light	75.6	76.5	69.3	73.0
Set 2—Groundwood Sulphite Subliner						
0	0	Heavy	71.7	75.0	63.0	68.1
1	0.66	Heavy	74.0	76.3	66.5	70.2
2	1.32	Heavy	75.1	77.7	66.8	71.8
3	1.92	Heavy	76.5	78.6	68.5	73.1
4	2.56	Heavy	77.4	79.4	70.0	74.5
0	0	Medium	70.4	72.7	60.2	65.8
1	0.66	Medium	73.6	75.5	65.0	70.0
2	1.32	Medium	75.0	77.0	67.0	71.8
3	1.92	Medium	76.4	78.0	68.7	73.2
4	2.56	Medium	77.1	79.0	70.0	74.3
0	0	Light	70.2	71.5	60.8	66.0
1	0.66	Light	72.7	74.3	64.9	69.4
2	1.32	Light	74.2	75.5	66.8	71.0
3	1.92	Light	75.4	76.7	68.5	72.7
4	2.56	Light	76.6	78.2	69.3	73.7

The Chemistry of Butanol Lignin*

By A. Bailey[1]

Abstract

A brief survey of the chemistry of butanol lignin is given, including its physical appearance, solubility, molecular weight, thermal behavior, salt formation, and carbon and hydrogen content.

The methoxyl content determination showed an increase from 19.7% for the original aspen butanol lignin to 31.2% for the distilled fraction, a decrease from 15.2 to 10.9% for free hemlock butanol lignin, and an increase from 8.9 to 9.8% for the total hemlock butanol lignin.

The principal reactions of butanol lignin reported are oxidation, acylation, alkylation, nitration, hydolysis, sulphonation, alkaline fusion, reduction, and catalytic hydrogenation, the latter yielding a dozen products distilling from 75 deg. C. at atmospheric pressure to above 180 deg. C. at 10^{-6} mm. of mercury.

The need for a solution to the problem of lignin utilization becomes more important each year. Even after a century of investigation, it must be admitted that the failure is not economic or engineering failure but simply the inability of chemists to learn the structure of lignin. It is toward this one objective that most lignin chemists are working today. It is the purpose of this paper to report the progress which has been made on the constitution of the butanol derivative of lignin.

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Survey of the Chemistry of Butanol Lignin

The reaction between butanol and lignin was discovered 12 years ago but it is within only the last few years that any attention has been directed toward its possibilities as a tool in determining lignin structure *(1)*. Very little information dealing primarily with the chemistry of butanol lignin has been published; it therefore appears desirable to review briefly its preparation and properties and to present additional experimental results on its chemistry.

Butanol lignin was prepared by heating wood with butanol in an autoclave at 160 deg. C. for several hours. Under these conditions the lignin dissolved in the alcohol to form a brown solution. If water and an alkali were present during the digestion, the lignin was removed rapidly and was water soluble. The addition of an acid precipated the lignin removed in alkaline medium and only in minor respects did this lignin appear to differ from that removed by alcohol alone.

Recovery of the lignin from a butanol solution was effected by extracting with water to remove sugars, and evaporating the alcohol to recover the solid butanol lignin. If a mixture of alcohol, water, and an alkali was used in digestion, the water layer was acidified, precipitating the lignin as a light brown gel, and dialyzed to remove sugars and salts.

The physical appearance of butanol lignin varied with the source, and conditions of isolation and drying. If precipitated from water and air dried before oven drying, it was usually a light tan amorphous powder. That recovered by evaporation of the alcohol was usually a dark brown tar which became a friable black resin upon drying. Regardless of isolation, oven drying in the presence of water usually gave rise to an abnormally low melting point (40 to 60 deg. C.) and the formation of a jet black resin. Since these resins were redissolved and reprecipitated from water to form a light tan powder, it is not believed that chemical changes take place in this blackening process.

Butanol lignin is unlike most lignin preparations in that it represents all the lignin in the wood and possesses good solubility in a variety of solvents reported by Bailey *(1)*. Poor solubility was found in most aliphatic solvents and others such as napthalene and cyclohexanol. Slight to moderate solubility occurred in some polar aliphatic compound, such as the lower saturated alcohols, and in some aromatic hydrocarbons. Good solubility occurred in highly polar aliphatic compounds, in substituted aromatic compounds (especially those containing a hydroxyl group) and in heterocyclic and dicyclic compounds.

The melting point of butanol lignin was about 120 deg. C.; decomposition occurred before boiling, even under reduced pressure. It was permanently thermoplastic and invariably cooled to a brittle, black resin.

The molecular weight as determined by the cryoscopic method using beta napthol, among other solvents, was 420.

Solubility data pointed strongly to aromatic constitution; solubility in sodium carbonate and hydroxide and insolubility in the bicarbonate indicated a phenol. Aromatic hydroxyls gave rise to complete solubility while benezene and cyclohexanol dissolved almost none of the lignin. A large number of salts were found with metals, presumably phenates. The Li, Na, K, NH_4, and V salts were soluble, while those of Al, Ba, Ca, Cu^{++}, Fe^{+++}, Fe^{++}, Pb, Mg, Hg, U, and Zn were insoluble.

Carbon and hydrogen content was generally similar to other lignin preparations, one analysis showing 60.75% C and 6.52% H. The only functional groups present were methoxyl and hydroxyl; tests for others gave completely negative tests. The methoxyl content was in the range of 18 to 20% in the hardwoods and 15% in the softwoods. Methylation of aspen butanol lignin with dimethyl sulphate raised the methoxyl content to 31.6%.

Purity of Lignin

It was noted in analytical work that dialysis failed to reduce the ash content below 0.4%, that the C content varied almost 2% from one batch of lignin to another, and that some solvents dissolved the lignin readily yet left small particles suspended in the solution. Accordingly it was considered essential to determine positively whether or not the lignin was a mixture.

Selected solvents were employed to learn whether or not the lignin could be fractioned. A Soxhlet apparatus was used with low boiling solvents and a lead-soldered brass cylinder with a condenser incorporated in the cover was used with high-boiling solvents. The filter cups in all cases were alundum crucibles of porosity R. A. 98. Solvents included petroleum ether, acetone, ether, butanol, cellosolve, benzene, benzyl alcohol, cyclohexanol, turpentine and dioxane. Petroleum ether, ether, benzene, and xylene dissolved almost none of the lignin. Water, methanol, and acetone, however, extracted lignin slowly until over 50% was dissolved. However, an unusually long time was required, the rate of extraction was often erratic, and cross extractions yielded anomalous results. It was found, for example, that methanol and acetone each extracted about 60 to 65% of the lignin. It was accordingly suspected that each solvent might be extracting the same fraction. Cross extractions, i.e., extracting the acetone-insoluble lignin with methanol dissolved 40.0%, and water extracted 60.0% of the methanol-insoluble lignin. These results were the opposite of what was expected, although fractions were thus provided for later analysis, to determine whether or not actual differences existed.

Discrepancies noted in duplicate extractions seemed to warrant a study of the effect of particle size, the variation from batch to batch, and the influence of different solvents. The influence of particle size upon solubility was determined by extracting one portion of a given lignin preparation, and repulverizing and extracting another portion of the same sample. This treatment increased the amount extracted by methanol from 60.8 to 93.7% and the amount extracted by acetone from 64.8 to 84.5%. The batch to batch variation was found to be from 60.8 to 72.8% although identical preparation, except for different times of dialysis, had been observed. The comparison of the effects of extraction by different solvents showed an anomalous behavior apparently following no general pattern except that smaller particle size increased the quantity of the extract, and that greater variations were observed with methanol than with acetone.

It therefore appeared that the extent of solubility varied in a manner too erratic to permit sound deductions regarding compositional changes. Due to the

abnormally long extraction periods, the low rate of solution, the appearance of turbidity in the extracting solutions, and the progressively higher proportion of larger particles left as a residue in the extraction cup, it was suspected that dispersion of the lignin as a sol in extraction liquid was responsible for the anomalous solubility.

A number of analyses of the methoxyl content of both the residues and dissolved portions of lignin were carried out by the TAPPI Standard T 2 m-34 *(5)*. All of the values for methoxyl content were grouped within a few tenths of a per cent of the methoxyl content of the original material. A typical series of analyses gave 19.5, 19.7, and 19.8% methoxyl for the original aspen butanol lignin; 19.5, 19.8, and 19.6% methoxyl in the methanol-soluble portion; and 19.5, 19.5, and 19.7% in the methanol-insoluble portion. Since the variation was no greater than the experimental error, it was impossible to determine whether or not a chemical difference actually existed between residue and soluble portion while the erratic nature of the solubility cast doubt as to whether solution or solation was the real cause. While it was believed that extraction was a severe test of homogeneity, it was concluded that the anomalous character of the extraction data failed to present positive evidence of either homogeneity or heterogeneity.

Removal of Inorganic Constituents

It has been noted that ordinary dialysis failed to remove all inorganic constituents. To learn whether or not this material was chemically combined or merely adsorbed, an electrodialyzer was employed. With a final potential of 150 volts and current of 2 to 3 ma., ash content was reduced to 0.01% or less, showing that no inorganic material was in chemical combination with the lignin and providing an organically pure material for analysis.

Fractionation of Lignin by Molecular Evaporation

Samples of lignin from various sources were subjected to evaporation in a molecular still at temperatures up to 220 deg. C. and pressures as low as 10^{-6} mm. of mercury *(2)*. All of the materials investigated were successfully evaporated although considerable difference in the ease of evaporation was noted. Butanol lignin prepared from different woods and representing both total and free fractions was subjected to evaporation. Determination of the methoxyl content of the original lignin and distilled fractions by the method of Peniston and Hibbert *(4)* showed an increase from 19.7% for the original aspen butanol lignin to 31.2% for the distilled fraction, a decrease from 15.2 to 10.9% for free hemlock butanol lignin, and an increase from 8.9 to 9.8% for the total hemlock butanol lignin. The effectiveness of this method of fractionation suggested its application to other types of lignin. Accordingly, a commercial lignosulphonic acid, sulphuric acid lignin, hydrochloric acid lignin, and cuprammonium lignin were also fractioned. The methoxyl content of the lignosulphonic acid decreased from 7.8% in the original to 6.2% in the distilled fraction, from 14.4 to 12.8% for hemlock sulphuric acid lignin, from 15.7 to 13.6% for hemlock hydrochloric acid lignin, and from 15.3 to 12.2% for hemlock cuprammonium lignin. None of the distilled fractions condensed in crystalline form nor was it possible to evaporate the lignin directly from the wood.

The fact that the methoxyl content of the distillate differed in every case from the original material was adequate proof of heterogeneity. The significance of this evidence is that the extensive analytical data reported in the literature, including the molecular weight and variable C and H content reported for butanol lignin, merely represent average values for all the compounds present and do not justify calculation of the empirical formula.

Preparation of Derivatives

The principal reactions of butanol lignin which have been studied in detail are oxidation, acylation, alkylation, nitration, hydrolysis, sulfonation, alkaline fusion, reduction, and catalytic hydrogenation.

The nature of the oxidation products appeared to depend chiefly on the oxidation potential employed. Permanganate, hydrogen peroxide, and chromic acid failed to yield any products except carbon dioxide, oxalic acid, and small quantities of acrid-smelling oils. Protecting this aromatic hydroxyl group with methyl or acetyl appeared to have no effect. The lignin was either recovered unchanged or oxidized almost to its end products with no intermediate compounds present. However, by using a lower oxidation potential such as that of nitrobenzene *(3)*, a yield of 23.5% of vanillin and 8.2% of a mixture of phenols was obtained.

The fully acetylated derivatives of butanol lignin were little different than the original lignin except that they were insoluble in cold dilute alkalies. They were readily hydrolyzed in warm alkaline solution and were fairly stable in acid solutions, thus permitting oxidation by chromic acid when dissolved in glacial acetic acid. No crystalline or significant reaction products were obtained. Since the original lignin was a mixture of compounds, the determination of acetyl content and calculation of the number of hydroxyl groups was not justified.

While the original aspen butanol lignin contained 19.7% methoxyl, the fully methylated product contained 31.6%. Aside from its insolubility in dilute alkalies, it was an amorphous light tan powder very much like the original material.

Nitrates prepared from butanol lignin were amorphous yellow solids having 4 to 5% nitrogen. No significant derivatives were obtained.

Hydrolysis of butanol lignin occurred only in acid solution. Hot dilute acid caused rapid hydrolysis; some hydrolysis by dilute acid at room temperature was noted upon several days standing. One invariable product of hydrolysis was a dark brown or black resin, apparently a polymer, since it was soluble to only a slight degree in the better solvents such as dioxane and completely inert and insoluble in aqueous and other common solvents. Acid cooks of wood in butanol precipitated this resin on the pulp. Another product of hydrolysis was a volatile fraction the nature of which will be detailed in a later report. Stability in alkaline solutions and the ease of hydrolysis suggested the acetal nature of butanol lignin, a possibility which is receiving experimental attention. The polymerization apparently involved the phenolic hydroxyls since the hydrolyzed lignin was insoluble in dilute alkalies. Furthermore, the methoxyl content of the hydrolyzed lignin resin was only 3.9% whereas the original contained 19.7%. Thus, additional phenolic hydroxyls had been produced, and also com-

bined with another radical since free aromatic hydroxyls would have caused solubility in dilute alkalies. It seems likely that the well-known tendency of some phenols to polymerize was operative here. The resin was too insoluble to permit determination of the molecular weight.

Sulphonation by sulphurous acid and sodium bisulphite failed; the only product being an alkali-soluble thermoplastic resin. It appeared that lack of solubility in the acid solution and consequent poor contact with the reagent was the primary cause of failure. Efforts are being made to sulphonate in other media and with other reagents.

Alkaline fusion of butanol lignin gave only a trace of vanillin and a small yield of a mixture of phenols.

Reduction with alkali and zinc yielded an amber oil of sweet odor, chiefly phenolic, which, after further examination, will be the subject of a later report.

Catalytic hydrogenation yielded a series of about a dozen products distilling from 75 deg. C. at atmospheric pressure to above 180 deg. C. at 10^{-6} mm. of mercury. Due to the inability of available fractionating columns completely to separate some of the compounds boiling a few degrees apart, to the occurrence of azeotropic mixtures, to the wide range over which the compounds occurred, the necessity of designing and fabricating special equipment to effect separation in certain portions of the range, the low yield of some of the products, and the need of larger quantities of butanol lignin, additional time is required before a comprehensive report can be made. The importance of the complete report on these products can be realized when it is recalled that all of the lignin of the wood is converted to butanol lignin, while the lignin used by other investigators in hydrogenation studies has represented not more than 60% of the total lignin and has resulted, thus far, in the identification of only four compounds. It therefore seems likely that the dozen products prepared from butanol lignin will throw additional light on the constitution of lignin, aiding the final elucidation of structure and the establishment of industrial utilization.

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The Applications and Limitations of the Rod Mill*

By Sidney D. Wells[1]

Abstract

Beating with rods has been found to be advantageous in the following applications: pulping of semicooked chips for the production of corrugating paper and test liner; pulping of kraft or sulphite screenings with the retention of greater fiber length than is usually the case; pulping of groundwood screenings for use in the finished groundwood papers with improved formation and freeness characteristics; pulping of rotary stock in strawboard manufacture with substantial savings in power, elimination of knots, and the retention of greater fiber lengths; utilization of rag waste contaminated with metal objects, wood, cork, rubber, etc., so as to separate the fibers from the nonfibrous constituents, and to utilize the former; preparation of rags for roofing manufacture; preparation of wood for roofing manufacture; preparation of wood for insulating wallboard manufacture; preparation of straw, cornstalks, bagasse, and other fibrous waste for wallboard manufacture; combined cooking and mechanical preparation of cereal straws for high-grade corrugating paper; preparation of fibrous agricultural waste for the separation and utilization of the pithy and nonfibrous constituents in board manufacture and the production of high grade bleached pulp from the fibrous constituents for use in high grade paper manufacture; liberation of ink from waste papers by maceration at high consistency in the presence of detergents and steam; nodulization of waste papers for gas absorption; pretreatment of kraft pulp for more efficient strength development; pretreatment of sulphate, soda, and sulphite pulps for more efficient and economical bleaching, with greater preservation of strength; pretreatment of pulps for improved formation.

In 1923 there was great interest at the Forest Products Laboratory in the development of methods of producing a high yield of pulp for paperboard and other special purposes by means of milder cooking conditions, using the recognized and also special cooking processes. When applied to wood chips, the softened chips required mechanical treatment to completely separate the fibers, and a search was constantly under way for the most suitable mechanical equipment for this purpose. While the laboratory hollander beater of 40 pounds capacity did a very good job, it was found, on taking the problem into the mill, that a high speed hollander beater of 2000 pounds capacity failed to separate the fibers completely even after a beating period of 24 hours. Swing hammer shredders, Impco refiners (now known as Haug refiners), Bauer refiners, jordans with special filling, and other equipment were found to do the work satisfactorily, but in some cases the power consumption seemed to be excessive. The work went on, however, and as a result we now have a new type of pulp in commercial production in amounts up to approximately 100,000 tons per year.

In December, 1923, the writer sent a barrel of semicooked chips to the Mine and Smelter Supply Company, Denver, Colorado, where they were beaten

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with rods in a small laboratory rod mill, and the pulp obtained was shipped back to Madison where it was run over the experimental paper machine into a very satisfactory sheet of wrapping paper. Beating with rods was evidently a feasible method of pulping fibrous material *(1)*.

The first extensive application of beating with rods occurred in the semichemical process with chestnut *(2)* which was adopted by the industry and which now provides a very substantial source of corrugating paper. Soon after, the idea was applied to the beating of straw *(3)* in the conventional strawboard operation and between 1925 and 1930 active interest was shown in the new method. Installation of a rod mill in a paperboard mill gave a much better product, increased production, and unexpectedly so reduced screenings that the 8-plate screens installed for screening the stock to each of the cylinders were found to be adequate after operation of the rod mill, whereas before its use it was impossible to supply stock to the paper machine at a rate sufficient to keep up with the capacity of the machine. Plans were underway for installing 12-plate screens in order to meet the demand. The installation of the rod mill made this step unnecessary. Not only was the amount of screenings materially reduced, but the freeness of the stock was increased because the work with the jordans was very much lightened by having cleaner stock with which to work, and the capacity of the driers was consequently increased owing to the greater freeness. There was less cockling of the product because of flatter drying, and in several other ways there were definite improvements.

One of the largest installations of rod mills was at a kraft mill which had been running on a mixture of kraft and sulphite pulps. Plans were underway for changing to 100% kraft and, since there was no room for doubling the beater capacity which would otherwise be necessary, three 7 by 16-foot Marcy rod mills were installed to pretreat the kraft pulp before it reached the beaters. Formerly 17 beaters were required to furnish stock for a production of 130 tons per day, so that the average time in the beater was two hours and 20 minutes, and the beaters consumed something like 900 h.p. It was found that the pretreatment with rods developed a strength of the stock to a point reached after four hours in the beaters so that, with the pretreatment, the beaters were giving the equivalent of six hours and 20 minutes, whereas before only two hours and 20 minutes were available. Later on, the beaters were reconditioned by streamlining and enlargement so that their

FIG. 1
View Showing Stock Decker and Rod Mill

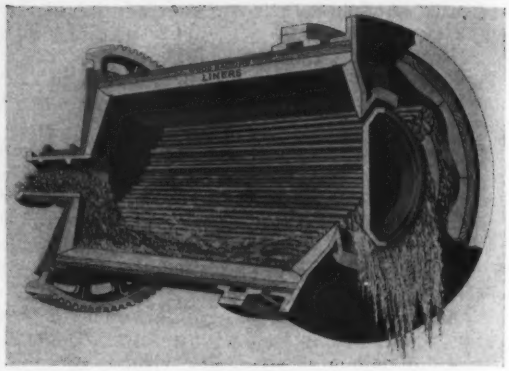

FIG. 2
Artist's Conception of Beating with Rods

power consumption was increased to 1200 h.p. The pretreatment with rods now was found to give the equivalent of two hours in the reconditioned beaters and the equivalent of four hours and 20 minutes was obtained. The stock was found to be freer for any definite strength development, formation was better, and the combined bursting (Mullen) strength and tearing strength was definitely improved.

At about this period rod mills were installed for the pretreatment of sulphite pulps. It was found that in unbleached sulphite pulp there is usually sufficient acid left after washing to cause a slight discoloration of the pulp treated with rods. In one mill, stainless steel rods were used to avoid this trouble. Where sulphite pulp was used for the production of paper boards, the discoloration was not sufficiently serious to cause trouble.

Where pulps are to be bleached, it was found best to give the rod mill pretreatment before the bleaching operation *(4)*. There was an actual saving in chlorine demand because the pretreatment released residues of cooking liquor which it was impossible to remove without such pretreatment. The strength development accomplished before bleaching was retained through the bleaching operation and the strength characteristics of the final product were better than where all the beating treatment was given after the bleaching operation.

Treatment with rods before bleaching also breaks up the shives and organic dirt so that they are bleached more nearly to the same color as the pulp and are not nearly so apparent in the bleached product. This is particularly advantageous in semibleaching which ordinarily makes the shives more apparent.

In strawboard manufacture, it was found that, by the use of the rod mill, some means of washing other than drum washers was necessary and for that reason screw presses, cane mills, or other dewatering devices have been applied with interesting results. A revamping of the scheme of operation so that washing occurs after the rotary, followed by the rod mill treatment, and then the jordan, made a very efficient flow sheet *(5)*.

Use in Ragging and Old Paper

Another application of the rod mill was the recovery of the fiber in the rags obtained from the ragging operation in paperboard mills where continuous breaker beaters are used. It is impossible to do anything with this material by any other method on ac-

count of the conglomerate mass of foreign matter, such as bottle caps, tin cans, wires, metal parts from clothing, etc., entirely mixed up with the rags. The rod mill completely separates the fibers of the rags so that products may be dumped back into the continuous beater and the fiber is incorporated in the stream of stock delivered therefrom. This application of the rod mill naturally led to the application of the rod mill for working up rags in roofing felt mills. A notable installation is in operation in which it was found that the quality of the product is very much better than that obtained before the rod mill was introduced into their flow sheet.

Another development was the use of the rod mill for the working up of old paper stock and delivering it in nodule form *(6)* for the removal of the ink by a special process. Telephone books are fed to a rod mill in a uniform stream, together with sufficient water, so that the nodules delivered by the mill are about 20% moisture-free basis. This application can be used in any of the methods for deinking and has the advantage of a continuous treatment at high density with perfect mixing and with the maximum effects from any steam or chemical applied. Being continuous, the labor involved is also very much less.

Up until 1932, interest in the application of beating with rods was very active in the paper industry. Since that time it has almost disappeared. The reason for this is probably because of the fact that, at the time of the inception of the basic idea, the inventor was an employee of the Department of Agriculture and therefore, in the year 1930, was required to dedicate it to the free use of the public. Since that time, with the exception of three special applications, which were then in the process of development, there has been no interest in further development on account of the fact that each application is a special case and requires considerable special engineering. Without any protection for the enjoyment of the benefits obtained by this special engineering, manufacturers of rod mills have had little incentive to go ahead.

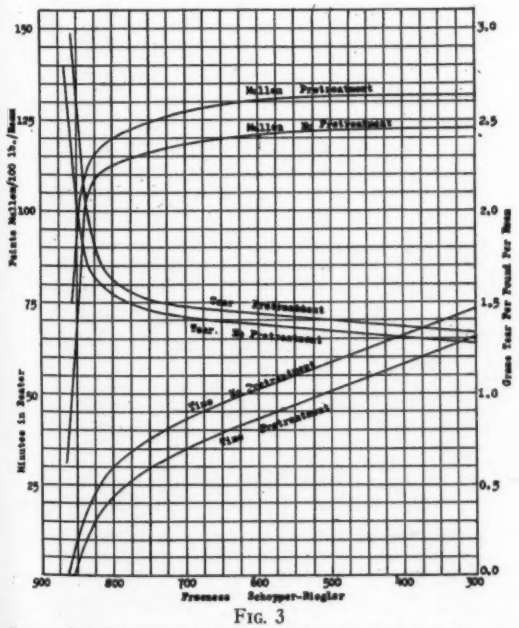

FIG. 3

Strength vs. Freeness and Time—Jack Pine Kraft Pulp Evaluation.

One manufacturer of rod mills realized that special engineering was involved and, in the period of 1925 to 1933, gave to the problem the attention that was necessary. As a result, every installation in the pulp and paper field made by this manufacturer has been successful and is now in operation. Such is not the case with other installations and, in the majority of cases, the rod mills that were once installed have been abandoned for one reason or another. Maintenance has been cited as one reason for such abandonment. This is hard to understand because, where a rod mill is properly designed and constructed, maintenance when operating on paper and pulp is practically zero. The writer is familiar with one installation of three large mills which has been operating continuously for 12 years on kraft pulps where there has been no item of maintenance except an occasional rod and an occasional liner bolt. The cost of these items per ton of pulp treated is insignificant. It is true, however, that in operation on pulp the mechanical stresses involved are greater than when rod mills are operating on ore or other mineral matter. Riveted construction should therefore be avoided and sturdy steel castings made use of throughout.

Experiments at the Institute

Since December, 1938, a 12 by 24-inch Marcy rod mill, ideal for laboratory study, has been available at The Institute of Paper Chemistry and several students have adopted studies in connection with beating with rods as the subjects for their theses, (two for a master's degree, and one for a doctor's degree).

Straw Pulping

One student, Pasquale A. Forni, has found that cereal straws can be pulped in the rod mill to the point suitable for manufacture into corrugating paper of exceptional strength. The chopped straw was fed directly to the rod mill with the proper amount of water and sodium hydroxide and steam was blown in to maintain a temperature of about 205 deg. F. Sodium hydroxide to the extent of 6% of the weight of the straw was necessary. The optimum range of consistency was 17.5 to 20%. Two rod mills in series would be required for this treatment, but when it is realized that two 9 by 20-foot Marcy rod mills, requiring 350 h.p. each, would replace twenty 14-foot globe rotaries, a stock pit building, 200 feet long and 40 feet wide, a beater room containing fourteen 2000-pound beater washers requiring 1500 h.p. for operation, the application would seem reasonable and economical. A 100-ton strawboard plant could well afford to install vacuum filters and a soda recovery plant in the space vacated by either rotaries, beaters, or stock pit and entirely eliminate the nuisance of stream pollution and maintain the chemical cost at what it now is with lime. The yield of paperboard is the same and the quality much better—e.g., 50% higher Reihle test and 50% higher burst test. Soda-cooked straw, as obtained in the rod mill treatment, can be combined with mixed paper stock in equal proportions and yet more than meet commercial specifications for nine point corrugating paper.

The limitations of the rod mill as at present constructed are that temperatures below 212 deg. F. must be used; sodium hydroxide is the only alkali at reasonable price that is sufficiently active to complete the softening action in the time available in continuous operation at temperatures below 212 deg. F. and

only plant fibers such as cereal straws, cornstalks, sugar cane, etc., are sufficiently susceptible to disintegration at temperatures below 212 deg. F. and in the presence of reasonable amounts of sodium hydroxide to yield satisfactory results.

BAGASSE PULPING

Another student, Joseph E. Atcheson, devoted his time to the study of the use of the rod mill as a first-stage treatment in a two-stage cooking process *(7)* for the pulping of bagasse from the pressing of sugar cane, cornstalks, and similar agricultural fibrous waste materials. He found that by treating bagasse in the rod mill at temperatures in the neighborhood of 200 deg. F. with the partially spent cooking liquor from the second stage of the process, which is a pressure cook on the partially pulped material from the rod mill, it was sufficiently pulped to completely liberate the fiber from the pith, which can then be removed by a screening operation; thus, the pressure cook is applied only to the more resistant, truly fibrous elements of the plant material. The pithy portions removed are extremely slow in formation properties and have been found to greatly enhance the strength and stiffness of boards or papers, such as nine point corrugating, when added to a furnish of waste paper stock or partially beaten kraft. Allowing $5 per ton for bagasse and a value of $10 per ton for the pith and fine fiber removed in the screening operation between the rod mill treatment and the pressure digestion, the cost of the ultimate bleached fiber is not over $36 per ton. Adequate amounts of material can be charged to the digester, thus avoiding the primary obstacle to the utilization of fibrous plant material in the past. The pith is removed before the more drastic stage of the process, thus avoiding excessive loss of cellulosic material or consumption of chemical, and the final fiber is free of nonfibrous constituents, is exceptionally clean, and is capable to use in a very wide range of paper products, many of which are in the high priced fine paper and specialty class. The cooking chemical is completely utilized and yet the final stage can be completed in the presence of an ample supply of active alkali.

Bursting and Tearing Strengths

The characteristics of the rod mill in developing strength with less fibrillation greatly favors formation. In a run on kraft paper of about one day's duration in which three rod mills in series were used, the production of the paper machine used was raised from 3600 pounds per hour to 4500 pounds with simultaneous increase in bursting strength and in tearing strength. The stock naturally formed better. Formation was furthermore obtained at a higher freeness, as was also the bursting strength and the tearing strength desired. On account of the greater freeness, more water was removed by the presses and the driers handled more paper without increasing the steam pressure or temperature.

At another time, machine operation on all four machines for a period of nine weeks, during which high grade bleached and unbleached northern kraft papers were being made, the results seemed to indicate that there was a definite benefit in both bursting strength and tearing strength, as well as in production on the paper machine by using two mills in series. It was consequently felt that the rod mill should be used as a means for accomplishing a very large part of the beating and refining *(8)*. Even as late as 1935 *(9)* it was still considered advisable to use it to the extent of two or three rod mills in series when applied to kraft pulp.

In recent years, however, improvements in jordan design and operation and the development of other types of refining equipment make it seem desirable to use the rod mill only to the extent of one in each line of stock flow, and thus obtain the greatest benefit possible in proportion to the number used. The only exception to this rule would be where exceptionally level formation is required.

Confirmation of the rule to use only one rod mill in each line of pulp when applied to the pretreatment of either kraft or sulphite pulp was furnished by the work of another of our students, Raymond E. Baker, for a doctor's degree. It has been known for some time that pretreatment of lap pulp with rods before strength development in the laboratory beater furnished a strength development curve in which the bursting strength developed faster and about 15% higher than was possible without the pretreatment. Baker planned to ascertain why this was so. He soon found that the improvement applied only to pulps which were taken either in the lap or sheet form and that when slush pulp was studied, there was no such improvement in the strength development curve. The only benefit obtained in the latter case was a decrease in the time necessary to reach ultimate strength on account of the work applied in the rod mill. Baker found that the benefit obtained was only attractive to the extent of a 10-minute pretreatment with rods, which was equivalent to the action obtained on a stream of 50 tons of pulp per day by passage through a 7 by 16-foot Marcy rod mill, requiring 182 h.p. running load. Treatment more than this was found to be more effective when applied with jordans or similar equipment.

Where a mill receives any or all of its pulp in lap or sheet form, the rod mill will convert it to slush pulp if it is received at a moisture content not less than 25% or in the neighborhood of the fiber saturation point. Pretreatment with rods made possible the attainment of any strength obtainable on the original slush pulp. The meeting of any definite strength specification is also possible with a considerable saving in power and at a higher freeness so as to make possible greater production on the paper machine of any given drying capacity.

Baker also discovered the astounding fact that strength developed at a given freeness was a straight line function of average fiber length, irrespective of whether the strength development was accomplished by a dull or sharp beater, or in a rod mill. Only in pretreatment equivalent to one passage through a commercial mill was the action entirely advantageous. Use of the rod mill to carry on the complete beater treatment consumed much more power than beaters and jordans and was equally as destructive to fiber length. It did give exceptional formation characteristics, however, and when this requirement is paramount, it might be desirable to use more than one mill in series.

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Douglas Fir as a Pulpwood*

A Modified Sodium Sulphite Process for the Pulping of Douglas Fir

By L. C. Haffner[1] and Kenneth A. Kobe[1]

Abstract

Douglas fir is the greatest wood supply available today, but no satisfactory pulping process exists for the production of commercial bleached pulp. The conditions have been determined under which Douglas fir can be pulped by a modified sodium sulphite process to give a high grade pulp. The optimum conditions are: 1.38 moles Na_2O per liter sulphited to a pH of 9.4, liquor ratio 4 liters per kg. dry wood, cooking at 360 deg. F. for 7 hours with 2 hours for raising the temperature. The pH of the liquor is the controlling factor in producing quality pulp. Douglas fir pulp is characterized by its high tear values and good burst (Mullen), with easy bleachability. Western hemlock also can be pulped under similar conditions to give a pulp with burst values approaching sulphate, good tear and easy bleachability.

The vast stands of Douglas fir existing in the Pacific northwest make it desirable that this species be available to the pulp industry as a pulpwood. The rapid growth of fir on cut over lands also allows fir to be put on an annual crop basis and be a perpetual supply of pulpwood in this region of the country.

The volumes of pulpwood available for cutting are shown in Table I, from data in surveys of the Pacific Northwest Forest and Range Station of the U. S. Forest Service.

The lumber industry has drawn upon these stands of Douglas fir, but the nonutilization of this species for pulp has necessitated that the lumber industry care for the entire cutting of fir. Having available a process for the pulping of fir, it is possible to combine the operations of the lumber mill and pulp mill to give a high degree of wood utilization, lower costs of lumber, lower costs of pulpwood, and a stabilization of the lumber industry by forcing out marginal operators using older and less economical methods.

TABLE I.—PULPWOODS OF WESTERN WASHINGTON AND WESTERN OREGON AVAILABLE FOR CUTTING

Species	Western Washington	Western Oregon	Total
Western Hemlock	5,879,000	16,424,000	22,303,000
Sitka Spruce	1,074,000	1,324,000	2,398,000
Balsam Firs	3,488,000	6,573,000	10,061,000
Mountain Hemlock and Engelmann Spruce	945,000	351,000	1,296,000
Black Cottonwood	64,000	122,000	186,000
Total	11,450,000	24,794,000	36,244,000
Douglas Fir	54,631,000	24,903,000	79,534,000
Total	66,081,000	49,697,000	115,778,000

Volume in thousands of cubic feet of pulpwoods available for cutting. Includes all trees four inches and more diameter at breast height. Excludes all timber reserved from cutting in municipal, state, and government ownership.

Previous Sulphite Pulping

The pulping of Douglas fir by the standard and modified calcium bisulphite processes has been investigated by a number of workers who perceived the importance of the problem. Wells and Rue *(15)* in their study of the suitability of American woods for paper pulp state that Douglas fir pulps with difficulty because of the pitchy character of the wood to give a pulp of fair strength and poor color, and that the bleachability is too high for commercial operation. Beuschlein *(4)* showed that the difficulty in pulping was not entirely due to the pitchy character of the wood, as extracted resin-free fir was more resistant to sulphite liquor than white spruce.

The most extensive work on the pulping of Douglas fir is that of Brookbank *(7)*, who attempted to find the mildest conditions for pulping. He pulped sapwood, heartwood, and an 85-15 mixture of the two representative of slabwood. His conditions were liquor, 6.00% free SO_2, 1.25% combined SO_2; liquor-wood ratio 7.1; digester pressure 85 pounds per square inch gage attained initially by compressed nitrogen; gas volume maintained constant. Temperature and time were the only two variables and the two cooking schedules called for either 10 hours ending at 145 deg. C., or 14 hours ending at 134 deg. C. In the shorter schedule only sapwood could be pulped, in the longer schedule mixtures representing slabwood and the entire tree could be pulped. The yields were about 50%, with a bleach consumption of about 16%. Brookbank believes that the long time cook on fir is feasible, because the density of the fir chip is greater than the spruce chip, so that the tonnage produced from a digester would be about the same with either wood. These calculations are based on the unstated assumption that the chips are from slabwood (85% sapwood and 15% heartwood) which has a density 1.33 times that of spruce. Based on the composition of the whole tree, Douglas fir, spruce, and hemlock all have approximately the same density. Brookbank notes the unusual properties of the pulp, high tear and low apparent density, which make it an unusual blending ingredient in various furnishes.

The ammonium bisulphite process has been investigated on Douglas fir by Benson and coworkers *(2, 3)* who were able to pulp sapwood directly and ammonia extracted heartwood.

The Sodium Sulphite Process

The sodium sulphite process has been known and operated spasmodically for a long period of time. The pulp produced is known for its desirable properties of high strength and easy bleaching, and commands a ready market. The variable results in pulping and the past unsatisfactory state of the recovery process have forced the decline to the point where only one mill in the United States operates such a process and that intermittently in conjunction with a sulphate mill so that the sulphite black liquor can be absorbed by the sulphate operations.

An excellent review of the work previous to 1926 on alkalies as bases for sulphite liquor was given by Hausen *(12)*. He describes the work done on the weakly acid, alkaline and neutral alkali sulphite pulping as done by early workers as Cross, Graham, Schwalbe and others up to the work of Drewsen.

Various modifications of their patents are described

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by Bradley and McKeefe *(6)* who subdivide the Keebra process into full-, acid-, thio-, sulpho-, semi- and carbo-, depending on the modifying chemicals present with the sodium sulphite. Their article has all the indefiniteness of their patents and gives no real information. However, the actual operation of several mills is described by Clark *(10)*. In the full-keebra process the cooking reagent in sodium sulphite (Na_2SO_3) only. The amounts of chemicals required are about 400 pounds Na_2O per cord of wood and about 450 pounds sulphur per ton of pulp. The cook is eight hours at 150 pounds per square inch for spruce and hemlock. The feasibility of the process and the excellent qualities of the pulp also are given by Drewsen *(11)*.

The scientific aspect of the pulping problem has been attacked by Chidester *(8)* who pulped white spruce, western hemlock, and slash pine. The cooking liquor was maintained constant at approximately 6% total SO_2 and the combined SO_2 increased by adding increasing amounts of sodium hydroxide to the liquor, thus varying the combined from 1 to 6%. Yield, bursting strength, and tearing strength all passed through a maximum value at 2 to 3% combined SO_2, fell to a minimum at 4.5 to 5% and rose again as the combined approached the 6% total representing sodium sulphite. The effect of various additions of chemicals on the pulping of sodium sulphite was studied by Chidester and McGovern *(9)* who added sodium hydroxide, sodium sulphide, and sodium bicarbonate to the sodium sulphite liquor to give pH values near 9 and 11. Yields were 41 to 43% with all reagents, and only sodium sulphide exerted any effect, which was an appreciable reduction in the bleach requirement of the pulp.

The lack of success of the calcium bisulphite process on Douglas fir and the success of the sodium sulphite process on many woods encouraged work on the application of the sodium sulphite process to Douglas fir and the determination of the optimum

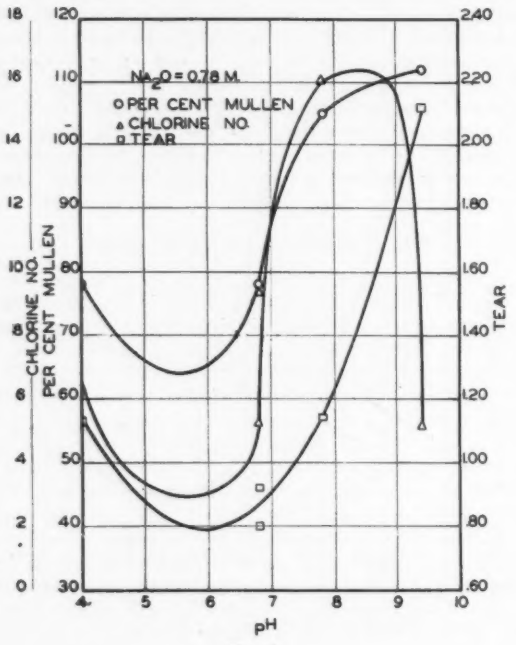

FIG. 1.
Physical Properties of Pulp at Various pH Values at 0.78 Moles Na_2O per Liter of Liquor

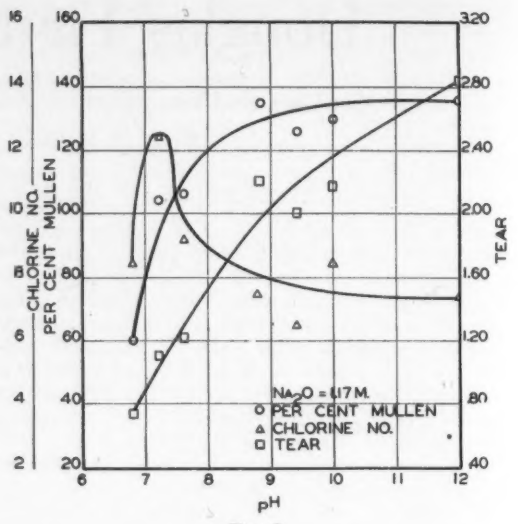

FIG. 2.
Physical Properties of Pulp at Various pH Values at 1.17 Moles Na_2O per Liter of Liquor

conditions for the production of a high strength, readily bleached pulp that would find ready market acceptance.

EXPERIMENTAL

The basic consideration of all the work was to make the experiments conform as closely as possible to mill operating conditions. Thus, all chips used were secured from mills operating on the particular wood. The Douglas fir ships were secured from the Everett Pulp and Paper Company and were produced from scantling lumber and logs too poor for sawmill use. Thus the wood was mainly old growth fir and no distinction was made as to sapwood and heartwood. As the chips were produced for a modified soda process they were not sized, dusted or otherwise selected so contained bark and knots. Moisture was determined on each lot of chips as used.

Cooks 145 to 198 were carried out in rotary digesters electrically heated by resistance elements wound on the body of the digester *(5)*. The capacity is 50 liters and the charge consisted of 4 kg. of moisture-free wood and 16 liters of liquor. Cooks 199 to 213 were carried out in a stainless steel digester of 240 liters capacity and heated by indirect circulation *(13)*. The charge here consisted of 37 kg. moisture-free wood and 150 liters of liquor.

The liquor was prepared by bubbling commercial SO_2 into sodium hydroxide solutions. The pH was determined with a colorimetric Hellige pH set. The ratio of liquor to dry wood was maintained constant at 4 liters to 1 kg. wood, which corresponds to 960 gallons per ton of chips, or 1920 gallons per ton of pulp, assuming a 50% yield. This ratio corresponds to the practice of sulphate mills but is lower than the ratio used in sulphite mills.

Preliminary experiments showed that the pulp produced under acid conditions did not have as satisfactory properties as that produced under alkaline conditions corresponding nearly to sodium sulphite. Further work in the acid range was abandoned and a complete investigation made of the controlling factors in the alkaline range. Under alkaline conditions impregnation occurs during the short heating up period, so that the digestor was brought to cooking temperature as rapidly as the heating facilities permitted.

Yields are reported only on the small cooks where all the pulp produced could be oven dried and weighed. Variables studied were cooking time and temperature, ratio of base to wood, ratio of base to sulphur dioxide, and pH.

Chemical Ratio and pH

The ratio of liquor to wood was maintained constant at 4 liter per kg. of dry wood. The ratio of base to wood is conveniently expressed in terms of the concentration of base in the solution, or moles Na_2O per liter of solution. Thus four times this value is the moles Na_2O per kg. dry wood, 248 times the moles Na_2O per liter is the grams Na_2O per kg. dry wood. The ratio of base to acid is expressed as Na_2O/SO_2, thus a 1.0 ratio represents Na_2SO_3. The pH of the solutions represent a variable readily determined and one which has a great influence on the characteristics of the pulp.

Although pulping can be carried out with 0.44 moles Na_2O per liter, equivalent to 11% of the weight of the dry wood, practical results are obtained with 0.78 moles Na_2O per liter, equivalent to 19.5% of the weight of the dry wood. Using this amount of chemical, the cooking conditions in the rotary digester were adjusted to a total time of nine hours ending with a three- to four-hour period at 360 deg. F. Using a constant 0.78 moles Na_2O per liter, the Na_2O/SO_2 ratio was changed and the physical properties of the pulp determined. The results of runs 145, 147, 149, 151 are shown in Fig. 1, in which the physical properties are plotted against the pH of the liquor.

It is seen that the physical properties pass through a minimum at a pH of about 6, but thereafter increase rapidly. The chlorine number also increases rapidly but at a pH of 9.4 drops to a low value while the burst and tear values remain at a maximum.

The influence of pH was studied at four other concentrations of Na_2O. In Fig. 2 are shown the data for 1.17 moles Na_2O per liter, in Fig. 3 for 1.50 moles Na_2O per liter.

A concentration of 1.17 moles Na_2O per liter corresponds to Na_2O equal to 29% of the weight of the dry wood, and 1.50 moles Na_2O per liter corresponds to 37.5%. With 1.17 moles Na_2O the best physical properties are found in the pH range of 9 to 12. With 1.50 moles Na_2O the best physical properties are found at a pH of 12, but bleachability is poor. In all cases a pulp of excellent properties is obtained at a pH of 9.4, so a series of runs was made in

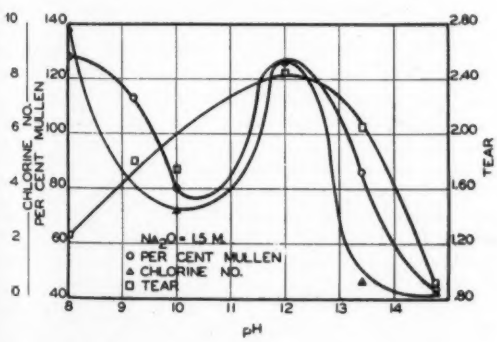

Fig. 3.
Physical Properties of Pulp at Various pH Values at 1.50 Moles Na_2O per Liter of Liquor

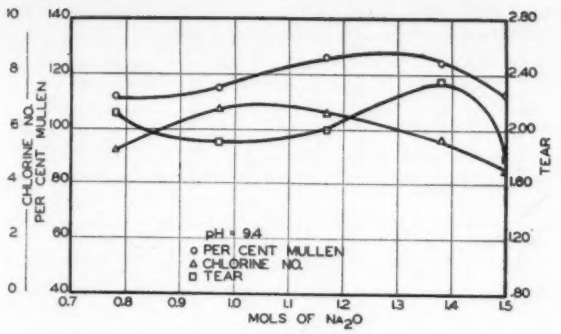

Fig. 4.
Physical Properties vs. Moles Na_2O per Liter at a Constant pH of 9.4

which the pH was maintained constant at 9.4 and variable Na_2O concentrations used, as 0.78, 0.97, 1.17, 1.38 and 1.50 moles Na_2O per liter. The results are shown in Fig. 4.

The maximum physical properties are found at 1.38 moles Na_2O per liter, corresponding to 34% of the weight of the dry wood. Further cooks (178 to 190) were made to evaluate the influence of temperature and time. A temperature of 360 deg. F. is necessary to produce a strong bleachable pulp. An increase to 370 deg. F. benefits the bleachability but decreases the strength of the pulp. Hemlock is more sensitive to temperature than Douglas fir and a process designed to operate on fir with the addition of the hemlock logged conjointly with the fir must operate with 360 deg. F. as an upper limit.

The operating data and physical properties of the pulp produced are given in Table II. Runs 145 to 198 represent runs in the small rotary digester.

Na_2O/SO_2 Ratio and pH

The relationship between the pH of a 1.0 moles Na_2O per liter solution and its SO_2 content is shown in Fig. 5.

At neutrality there is an excess of SO_2 over sodium oxide amounting to 0.2 moles. At the equivalence point, or Na_2O/SO_2 of 1.0, the pH is 8. At a pH of 9.4 where the best pulping is obtained the base is 0.1 mole in excess of the acid. At pH values of 10 and 12 rapid breaks occur in the curve, the former occurring at the best value for low bleachability and the latter at the upper limit for strong pulp.

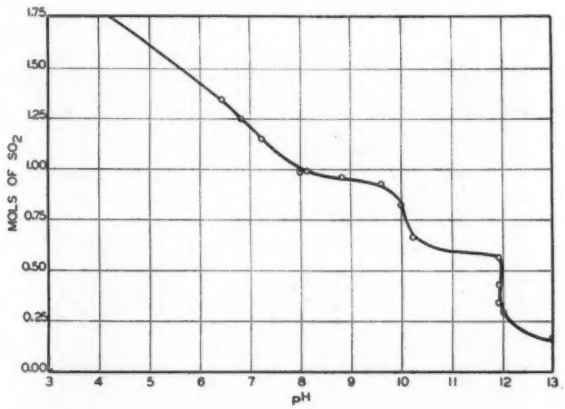

Fig. 5.
pH of Solutions Containing 1.0 Moles Na_2O per Liter and Variable SO_2 Content

Yield data were taken on five cooks and the results shown in the following table.

Cook	Moles Na_2O per liter	Dry Pulp % dry wood
173	0.78	47
174	0.98	47
175	1.17	44
178	1.38	43
172	1.50	41

The yield of dry screened pulp is expressed as percentage of the dry wood pulped.

Pilot Plant Operation

The small scale operation showed the optimum conditions as pH 9.4, 1.38 moles Na_2O per liter and a cooking temperature of 360 deg. F. It was desired to transfer these results to a digester capable of producing 30 pounds of pulp per charge. This larger digester (*see* Fig. 6) is of stainless steel construction with external heating and circulation. The results from this digester can be transferred to a commercial digester.

The chlorine numbers of the pulp were too high to come within the range of easy bleaching pulps, so that in making runs 199 to 213 on a large scale, the cooking time was varied from 4.3 to seven hours. The longer cooking time corresponds with the lower chlorine numbers, and contrary to expectation the stronger grades of pulp are obtained at the longer cooking time. This relation holds good for both Douglas fir and hemlock.

In Table II, runs 199 to 213, are given the operating conditions and physical properties of the pulp produced.

Bleaching

The pulp produced in about half of the large scale cooks was bleached in a laboratory bleacher *(14)*. The pulp was subjected to a first-stage chlorination using 80% of the total chlorine indicated by the chlorine number. The pulp was washed, the pH raised to 10 by the addition of sodium hydroxide and the pulp again washed. The second stage consisted of a sodium hypochlorite bleach to a brightness[2] of 80. The pH during this stage was maintained at 10 by the addition of sodium hydroxide, if required. To overcome the tendency towards color reversion on drying, which may be expected of alkaline pulps, the final wash water contained small quantities of sodium hexametaphosphate (Calgon).[3] This wetting agent apparently aids in the removal of the loosely bound lignin or color bodies that cause color reversion.

[2] Obtained with G.E. reflectionmeter.
[3] Proprietary water softener of Calgon, Inc., Pittsburgh, Pa.

Fig. 6.
Pilot Plant Pulp Laboratory at the University of Washington

Physical Properties

The physical properties of the pulp produced are given in Table II. All physical tests were carried out in the laboratory of the Soundview Pulp Company at Everett, Washington, by one of their chemists according to their regular laboratory procedure used on their pulp. The weight of a sheet size 6.5 by 6.5 inches is taken. Burst (Mullen) is the average of nine pops divided by the sheet weight times 100. Tearing strength by the Elmendorf is determined five times on four strips 165 by 63 mm. Tearing resistance is the *(average tear)* (4) (100)*/average sheet weight.* Freeness is determined in the Schopper-Riegler freeness tester. In Table II the last value marked *SV* represents the physical properties of unbleached slush pulp produced by the Soundview Pulp Company from hemlock.

In Table III are given the physical properties of the bleached pulp. Again the last value *SV* represents Soundview bleached hemlock.

The sodium sulphite pulp from Douglas fir is characterized by good burst values, 145 being easily obtained. The most important characteristic is the high tear strength, values in excess of 200 usually being obtained. Thus the pulp may be beaten to obtain a higher burst while maintaining acceptable tear values.

The sodium sulphite pulp from hemlock shows burst values equal to sulphate pulp and higher tear values than are commonly obtained with sulphite. These properties are combined with the easy bleaching properties of a sulphite pulp.

Chemical Properties

A chemical analysis of the pulp was made from an unbleached fir (run 201) and a bleached sample (run 200). The results are:

Run	201	200
State	Unbleached	Bleached
Alpha-cellulose, %	91.1	88.6
Copper number	1.3	1.2
KOH soluble	14.8	19.4
Cuprammonium viscosity, seconds	5.0	1.3

The chemical analyses compare very favorably with rayon grades of sulphite pulp. The viscosity is relatively low compared to rayon sulphite, but this may be an inherent property of the pulp as a modified chemical sulphate pulp from fir also showed a low viscosity.

Hemlock and Other Woods

Stands of Douglas fir timber are interspersed with western hemlock, the amount varying from 10 to 50% of the stand. In lumbering operations this would be removed with the fir, but all of it would go into pulping and none to the sawmill. Thus a process operating on fir must be able to utilize the hemlock, preferably being able to cook a mixture of the two woods under the same conditions. The pulping conditions for hemlock have been studied, both on a laboratory and pilot plant scale. As previously pointed out, hemlock is more sensitive to the temperature and time of cooking than is fir. A temperature of 360 deg. F. is the upper limit for hemlock and the time is usually reduced from that necessary for fir. The properties of the pulp are given in Table II, runs 202, 203, 207 and 208. The properties of the bleached

hemlock are given in Table III, runs 206, 209 and 213.

Southern pine chips were obtained from the Herty Laboratory and pulped experimentally. The results are given in run 196.

Cottonwood and aspen also were cooked. The results are given in runs 193 and 195. These woods overcook easily and both the temperature and time can be reduced to give good pulp.

Thus it is apparent that all types of wood can be pulped by this process to give excellent grades of pulp.

Thiosulphate

In regenerating the pulping liquor thiosulphate is often formed along with sodium sulphite. Previous investigators report deleterious effects of thiosulphate and place the upper limit as 5% of the total chemical. The effect of thiosulphate was determined by adding 0.1 mole $Na_2S_2O_3$ per liter to the pulping liquor, equivalent to about 8% of the total chemical content. The data are given in run 187, showing no deterioration and instead, a somewhat improved burst and tear. Aronovsky and Gortner *(1)* report sodium thiosulphate to be a strong pulping reagent. The results shown in this run indicate that under the proper conditions thiosulphate is not deleterious, but may be an accessory pulping agent. Further work on this phase of the problem is in progress.

TABLE III.—PROPERTIES OF BLEACHED PULP

	Initial			Maximum				
Run	Burst	Tear	Freeness	Burst	Tear	Freeness	Brightness	Wood
200	39	318	890	110	150	270	80.9	Fir
206	74	374	880	160	162	320	82.0	Hemlock
209	92	295	890	172	144	320	81.2	Hemlock
210	63	353	890	134	176	310	81.1	Fir
211	60	375	880	145	202	260	79.3	Fir
212	55	361	880	140	220	280	81.2	Fir
213	97	282	880	169	143	310	80.8	Hemlock
SV	54	280	880	111	135	610	85-90	Hemlock

Recovery

No review of the various recovery processes proposed or operated in the past will be given here. Work on this important phase of the problem indicates that a satisfactory solution of the problem is available. Work on this phase will be reported in another paper.

Conclusions

Douglas fir can be pulped successfully by a sodium sulphite process to give a pulp of superior physical properties.

TABLE II—PULPING DATA AND TESTS

							Initial			Maximum					
Run	Moles Na_2O liter	Ratio Na_2O/SO_2	pH	Cooking Temp. deg. F.	Total Cooking Time	Time on Temp.	Burst	Tear	Freeness	Burst	Tear	Freeness	$KMnO_4$ number	% Cl_2	Remarks
145	0.82	0.93	7.8	355	9-00	3-45	38	216	900	105	115	180	27.7	16.1	Uudercooked pulp
146	0.44	0.79	6.8	355	10-00	4-45	51	159	870	78	80	100	18.2	9.31	Undercooked pulp
147	0.78	0.55	4.0	355	5-40	1-00	48	148	870	78	113	330	13.6	6.39	Undercooked pulp
149	0.78	0.80	6.8	355	9-00	2-40	57	112	870	78	92	210	11.4	5.29	Undercooked pulp
151	0.78	0.74	6.6	355	9-00	3-15	68	98	840	86	65	200	11.3	5.29	Hemlock
153	1.17	0.86	7.2	360	9-00	3-20	55	210	890	104	110	200	22.5	12.4	
154	1.17	0.79	6.8	350	9-00	3-20	49	111	860	60	73	360	16.5	8.5	
157	1.17	1.02	8.8	360	9-00	3-30	54	317	900	135	220	600	15.0	7.52	
158	1.23	0.85	7.0	360	12-40	3-00	66	169	880	98	106	400	20.6	11.1	
159	1.18	0.90	7.6	360	9-00	2-45	61	209	870	106	121	260	17.7	9.2	
160	1.19	1.66	12.0	360	9-00	3-15	42	352	890	136	283	240	14.8	7.4	
161	1.17	1.17	10.0	360	9-00	3-30	50	331	890	130	217	230	16.4	8.5	
162	1.51	6.3	13.4	360	9-25	3-40	35	97	770	40	86	330	3.3	1.46	
163	1.52	6.2	13.4	360	9-00	4-15	37	262	870	86	204	380	1.5	0.65	
164	1.51	1.2	9.6	360	8-00	3-00	46	193	870	72	153	300	5.8	2.6	
165	1.49	1.26	10.0	360	7-00	1-15	39	260	880	80	173	200	6.9	3.2	
166	1.50	1.19	9.2	360	6-30	1-20	37	367	900	116	354	350	12.5	6.1	
167	1.50	1.02	8.0	360	7-30	2-05	51	251	900	128	125	180	19.1	9.9	
168	1.53	7.25	14.0+	360	6-40	2-00	21	49	410	20	44	200	5.2	2.4	
170	1.50	7.3	14.0+	360	5-00	1-45	36	138	780	43	92	220	0.6	0.25	
171	1.53	3.5	12.0	360	6-00	3-00	44	288	890	126	244	220	16.8	8.6	
172	1.54	1.18	9.2	360	9-00	3-45	55	259	860	113	179	330	9.5	4.49	
173	0.78	1.18	9.4	360	9-00	5-45	38	228	880	112	212	260	10.8	5.2	
174	0.97	1.18	9.4	360	9-00	3-45	47	288	890	115	190	190	13.7	6.74	
175	1.17	1.18	9.4	...	9-00	5-15	50	284	880	126	200	200	13.4	6.59	
176	1.38	1.18	9.4	360	9-00	5-15	48	311	890	124	235	190	11.7	5.64	
178	1.38	1.18	9.4	335	9-00	4-15	29	267	880	130	187	460	25.1	14.07	Too low temp.
179	1.38	1.18	9.4	350	9-00	4-45	42	276	870	121	232	230	17.3	8.88	
180	1.38	1.09	9.4	350	7-30	3-30	47	300	900	130	190	240	24.2	13.41	
181	1.38	1.09	9.4	350	8-30	4-15	42	299	890	123	239	290	22.2	12.04	
182	1.38	1.09	9.4	360	7-30	3-30	44	260	880	118	232	440	20.2	10.68	
183	1.38	1.09	9.4	340	9-00	4-35	..	...	...	...	...	...	...	.....	Too low temp.
184	1.38	1.05	9.4	350	9-00	4-20	115	291	850	185	158	340	21.0	11.21	Hemlock
185	1.38	1.05	9.4	360	7-30	5-10	94	311	870	173	142	370	19.7	10.36	Hemlock
186	1.38	1.05	9.4	360	7-30	4-15	46	330	890	142	219	360	18.9	9.85	
187	1.38	1.06	9.4	360	7-30	3-10	48	316	890	144	236	440	20.6	10.92	0.1 mole/liter $Na_2S_2O_3$ added
188	1.38	1.06	9.4	340–380	6-00	3-00	..	...	...	...	...	...	...	...	
189	1.38	1.06	9.4	370	7-30	3-20	55	305	880	130	212	480	14.0	6.94	
190	1.38	1.06	9.4	370	7-30	3-45	75	184	880	118	89	330	9.0	4.24	Hemlock
191	1.38	1.05	9.4	360	7-30	4-00	26	98	850	117	103	460	8.6	4.02	Cottonwood, overcooked
193	1.38	1.05	9.4	350	6-30	3-10	28	109	870	113	80	280	13.5	6.64	Cottonwood
195	1.38	1.05	9.4	360	6-30	3-00	34	104	840	100	...	240	11.2	5.39	Aspen
196	1.38	1.05	9.4	360	7-30	3-35	60	291	900	134	130	260	18.9	9.85	Southern pine
										132	220	310	13.1	6.44	0.1 mole/liter $Na_2S_2O_3$ added
198	1.38	1.05	9.4	360	8-25	4-15	58	382	890						
199	1.38	1.05	9.4	360	8-30	6-00	56	393	860	129	244	340	12.9	6.33	
200	1.38	1.05	9.4	360	8-00	5-45	63	364	890	118	203	300	11.9	5.77	
201	1.38	1.05	9.4	360	8-00	6-00	61	369	880	134	210	320	16.7	8.52	
202	1.38	1.05	9.4	360	7-15	5-30	81	421	880	179	166	230	18.2	9.43	Hemlock
203	1.38	1.05	9.4	360	7-15	5-00	96	322	890	177	168	500	19.5	10.24	Hemlock
204	1.38	1.05	9.4	360	8-30	6-30	68	...	...	...	...	...	22.3	12.11	
205	1.38	1.05	9.4	360	8-30	7-00	64	...	...	...	...	...	23.8	13.16	
206	1.38	1.05	9.4	360	7-30	4-20	..	...	...	...	...	...	16.3	8.28	Hemlock
207	1.38	1.05	9.4	360	7-15	5-10	98	340	890	176	164	240	21.2	11.35	Hemlock
208	1.38	1.05	9.4	360	8-00	6-00	96	362	890	178	167	260	18.6	9.67	Hemlock
209	1.38	1.05	9.4	360	9-00	7-00	..	...	...	...	...	...	9.0	4.24	Hemlock
210	1.38	1.05	9.4	360	9-00	7-00	..	...	...	...	...	...	8.5	4.02	
211	1.38	1.05	9.4	360	9-00	7-00	..	...	...	...	...	...	8.2	3.82	
212	1.38	1.05	9.4	360	9-00	7-00	..	...	...	...	...	...	8.3	3.90	
213	1.38	1.05	9.4	360	9-00	7-00	..	...	...	...	...	...	8.1	3.77	Hemlock
SV	...	...	...	...	....	....	73	180	860	122	140	510	...	....	Hemlock

Runs 145 to 198 in 25-or 50-liter digesters
Runs 199 to 213 in 240-liter digester
Wood used is Douglas fir unless otherwise noted.

The optimum conditions are: 1.38 moles Na_2O per liter sulphited to a pH of 9.4, liquor ratio 4 liters per kg. dry wood, cooking at 360 deg. F. for 7 hours with 2 hours for raising the temperature.

Douglas fir pulp is characterized by its high tear values and good burst, with easy bleachability. Hemlock pulp has burst values approaching sulphate, good tear, and easy bleachability.

The pH of the pulping liquor is the controlling factor in producing quality pulp, the range for best results is at a pH of 9 to 12. A pH of 9.4 produces the best average result, while the higher pH values benefit the chlorine number at a sacrifice of physical properties.

Hemlock, southern pine, cottonwood, and aspen were successfully pulped.

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Renew Paper Research Agreement

Announcement is made that a new agreement between the Dominion Government, McGill University and the Canadian Pulp and Paper Association relating to the Pulp and Paper Research Institute of Canada has been made for a further five years from August 1, 1940, with a clause making it renewable for further similar periods at the option of the parties concerned.

At a meeting held recently for ratification of this agreement there were present Dr. C. Camsell, Deputy Minister of Mines and Resources, representing the Dominion Government; Principal Dr. F. Cyril James representing McGill University, and Mr. F. G. Robinson, President of the Canadian Pulp and Paper Association.

The tri-partite agreement covers the operation of the Pulp and Paper Research Institute which is located at 3420 University street, Montreal, and which was established by the Canadian Pulp and Paper Association at a cost of about $325,000.00 in 1927 for the carrying on of research and development work to improve the position of the Canadian pulp and paper industry in relation to world-wide competition. Each of the three parties to the agreement contributes substantially equally in cash and services to the operation of the Institute. Under the new agreement the work in the Institute is now co-ordinated into one comprehensive plan of research and development calculated to contribute materially to the benefit of the industry.

The general administration of the Institute is vested in a Joint Administrative Committee comprising representatives of the Government, the University and the industry. The chairman of this committee is R. L. Weldon, president of Bathurst Power and Paper Company Limited.

Dr. O. Maass, head of the Chemistry Department of McGill University, recently made a Fellow of the Royal Society, has been appointed director of the Research Institute and he will be assisted by Dr. W. B. Campbell as director of Technical Research.

Dr. H. Hibbert, E. B. Eddy professor of Industrial and Cellulose Chemistry at McGill University, will continue to devote his whole time to the work of research for the industry.

The Pulp and Paper Research Institute of Canada is unique in that the Government, McGill University and the industry co-operate on research activities and in the training of chemists and other technical workers for the industry. Thus, Canada's largest manufacturing industry has organized itself to keep abreast of developments, to seek new products, extend its markets, and to keep in the vanguard of world competition.

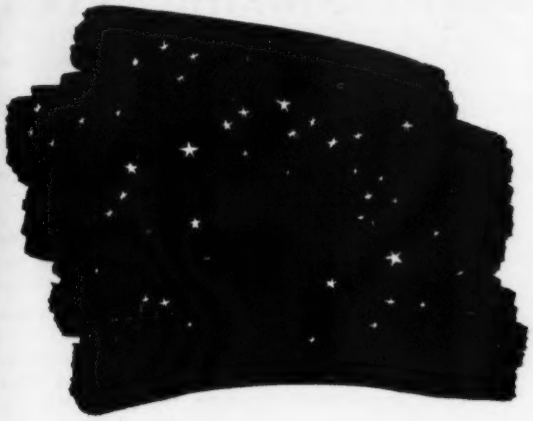
Complete Third Intensive Course

All of the men enrolled for the Intensive Course in the Fundamentals of Lithography sponsored by the Lithographic Technical Foundation and offered at the New York Trade School successfully completed their work on August 30. Of the fifteen men comprising the 1940 class, one came from Costa Rica, 3 from Canada, 3 from New York, 2 from Maryland and one each from California, Massachusetts, Missouri, Ohio, Rhode Island and West Virginia.

Twelve of these men will spend four days—September 3 to 6—in Rochester where they will secure special instruction at the Eastman Kodak Company.

Professor Paul W. Dorst, member of the Foundation's Research Staff, who was in New York especially for the purpose for three weeks, headed the list of lecturers on the scientific aspects of lithography. Other lecturers were Fulton MacArthur, Richard W. Gardner and John McMaster, Eastman Kodak Company; Michael Annick, Rutherford Machinery Company; A. Stull Harris, Harris-Seybold-Potter Company; Wm. Echkart, R. Hoe & Co.; S. Karpeles, Imperial Paper and Color Corporation; Mr. Chester Pope, Pope & Gray; B. D. Stevens, Miehle Printing Press and Manufacturing Company; Wm. R. Maull, the Mead Corporation; and Dr. Joseph Mattiello, Hilo Varnish Company.

Visits to the following plants were also included in the course: Brett Lithographing Company, Zeese-Wilkinson, Intaprint Corporation, United States Printing & Litho. Co., Jersey City Printing Company, Swart-Reichel, Inc., Huebner Laboratories, Interchemical Research Laboratories, Sinclair & Valentine Company, Vulcan Proofing Company, Dill & Collins Company and Gevaert Company of America.



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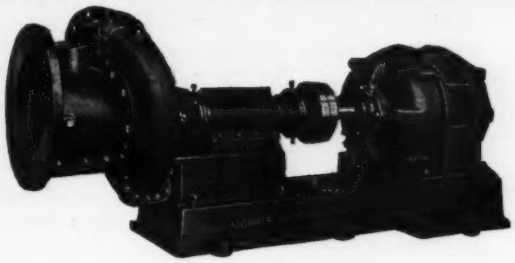

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Effective September 30, 1939, under Treasury Decision 49,970, all publications, exchanges and trade associations, were denied access to import manifests at the New York Customs House. The Paper Trade Journal and other interested parties have vigorously protested this ruling, and as soon as the order of the Treasury Department is modified or rescinded, full publication of all manifests will be resumed in these columns. In the interim, the Paper Trade Journal is making every possible effort to gather all available information from manifests, at various outside sources.

NEW YORK IMPORTS

WEEK ENDING AUGUST 24, 1940

SUMMARY

Wall paper .....12 cs.
Newsprint .....14,135 rolls

WALL PAPER

International F'd'g Co., ———, Petsamo, 12 cs.

NEWSPRINT

H. G. Craig Co., Inc., ———, Donnacona, 384 rolls.
International Paper Co., ———, Gatineau, 283 rolls.
———, ———, Liverpool, N. S., 3,897 rolls.
H. G. Craig Co., Inc., ———, Donnacona, 377 rolls.
———, ———, Comeau Bay, 6,144 rolls.
H. G. Craig Co., Inc., ———, Donnacona, 317 rolls.
———, *Brand*, Comeau Bay, 2,447 rolls.
International Paper Co., ———, Gatineau, 286 rolls.

RAGS, BAGGINGS, ETC.

W. Intner Co., ———, Bombay, 200 bls. cotton waste.
Padawer Co., ———, Bombay, 448 bls. cotton waste.
Green Textile Associates, ———, Bombay, 550 bls. cotton waste.
———, *Mormacyork*, Santos, 19 bls. rags.
Chase National Bank, *Mormacyork*, Santos, 19 bls. rags.
Chase National Bank, *Mormacyork*, Santos, 9 bls. old rags.

CASEIN

A. Hurst & Co., ———, Buenos Aires, 850 bags, 40,000 kilos.
T. M. Duche & Sons, *Mormaclark*, Buenos Aires, 500 bags, 30,000 kilos.
American British Chemical Supplies, *Donald McKay*, Buenos Aires, 2,500 bags, 125,000 kilos.
T. M. Duche & Sons, *Donald McKay*, Buenos Aires, 834 bags, 50,040 kilos.

BOSTON IMPORTS

WEEK ENDING AUGUST 24, 1940

A. Hurst & Co., *Donald McKay*, Buenos Aires, 100 bags casein, 6,000 kilos.

BALTIMORE IMPORTS

WEEK ENDING AUGUST 24, 1940

American Cyanamid & Chemical Corp., *Donald McKay*, Buenos Aires, 1,667 bags casein, 100,020 kilos.

LOS ANGELES IMPORTS

WEEK ENDING AUGUST 24, 1940

———, ———, Kobe, 8 cs. transparent paper, 2 cs. rice paper.
———, ———, Kobe, 1 cs. rice paper, 1 cs. writing paper.
———, ———, Yokohama, 6 cs. hanging paper, 1 cs. writing paper.

To Exhibit at N.P.T.A. Meeting

The following concerns have made arrangements to exhibit their products in connection with the annual fall meeting of the National Paper Trade Association to be held at the Stevens Hotel, Chicago, September 23 to 25 inclusive:

Ajax Box Company, Allied Paper Bag Corporation, American Paper Goods Company, Bay West Paper Company, Better Packages, Inc.; Brown Company, Central Paper Company (Menasha), Central Paper Company, Inc. (Muskegon); Cleveland Mill and Power Company, Container Corporation of America, Continental Bag Specialties Corporation, Crystal Tissue Company, Dixie-Vortex Company, The Dobeckmun Company, Fort Howard Paper Company, Freeman Paper Company, John M. Hart Company, Inc.; Hoberg Paper Mills, Hooven & Allison Company, Lily-Tulip Cup Corporation, Loroco Industries, Inc.; Maryland Paper Products Company, McLaurin-Jones Company, Midland Products Inc., National Soda Straw Company, Nekoosa-Edwards Paper Company, Orchard Paper Company, Pejepscot Paper Company, Racquette River Paper Company, Roxford Paper Company, Sanitor Manufacturing Company, Sealright Company, Inc.; Self-Locking Carton Company, Sherman Paper Products Corporation, Sorg Paper Company, Sutherland Paper Company Tomahawk Kraft Paper Company, Union Bag & Paper Corp., Universal Paper Products Company, Victoria Paper Mills Company, and Wisconsin Tissue Mills.

"Stonite" Patent Upheld on Appeal

A decision has been handed down by the United States Circuit Court of Appeals on the appeal entered by The Cincinnati Rubber Manufacturing Company from the decision of the United States District Court in the suit brought by Stowe-Woodward, Inc., for infringement of their patent on "Stonite" top press and smooth press rolls.

The Court sustained the patent on all claims and affirmed the order of the District Court perpetually enjoining The Cincinnati Rubber Manufacturing Company from infringing the "Stonite" roll, and gave judgment for damages.

Empire State TAPPI to Meet

The Empire State Section of the Technical Association of the Pulp and Paper Industry will hold its next meeting at the Lake Placid Club, Lake Placid, N. Y., September 27-28, 1940. The meeting will be held jointly with the New York-Canadian Division of the Superintendents Association. Information may be obtained from the section secretary, M. H. Bennett, Stebbins Engineering and Manufacturing Company, 363 Eastern Boulevard, Watertown, N. Y. A program will be published soon. Reservations may be made with the Lake Placid Club.

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Finish. Entire instrument heavily chrome plated as protection against moisture, corrosion and insuring a permanently clean attractive appearance.

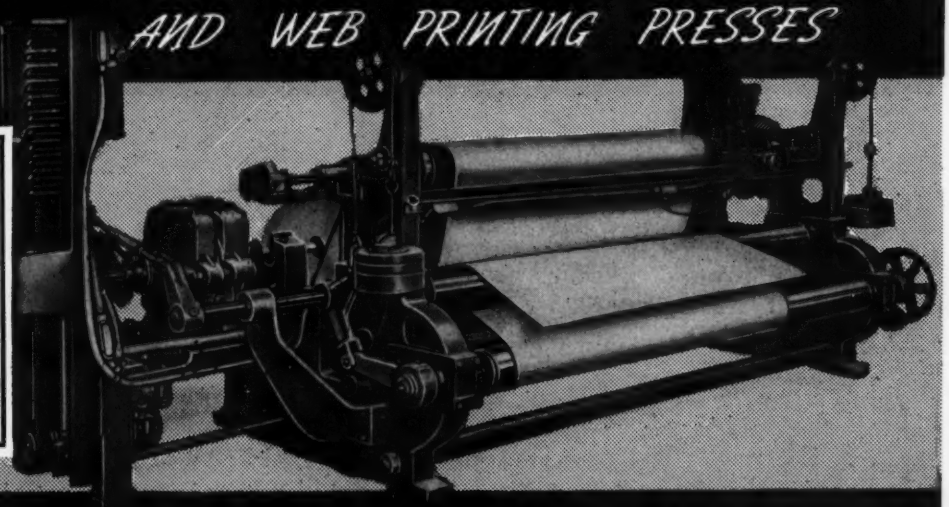
AMERICAN BUILT

WILLIAMS APPARATUS CO., INC.

HERALD BLDG. WATERTOWN, N. Y.

ELECTRIC EYE SIDE REGISTER CONTROL

USED WITH SLITTERS, WINDERS AND WEB PRINTING PRESSES



Keeps web running true by photo-electic means on Slitters, Winders, Web Printing Presses, Coaters, Waxers and other roll processing machines.

CAMERON MACHINE COMPANY - 61 POPLAR ST. BROOKLYN, N.Y.

CONSTRUCTION NEWS

Lynchburg, Va.—The Mead Corporation, Heald Division, manufacturer of paper board products, has plans nearing completion for one-story addition, 100 x 300 feet, reported to cost over $85,000, with equipment. Erection will be carried out early in fall.

Norwood, Mass.—Bird & Son, Inc., East Walpole, Mass., manufacturer of wall board, press board and other paper board products, plans new one-story plant at Norwood, estimated to cost close to $50,000, including equipment. Bids have been asked on general erection contract and work is scheduled to begin soon. Ganteaume & McMullen, 99 Chauncy street, Boston, Mass., are consulting engineers.

Camas, Wash.—The Crown Willamette Paper Company, manufacturer of book, kraft and other paper, has plans maturing for new one-story addition for expansion in beater department. No estimate of cost announced. Company also plans another smaller one-story building, about 30 j 30 feet, for extensions in office and operating department. Contracts for erection of both structures are scheduled to be awarded soon.

Miami, Fla.—The Benner Box and Printing Company, Miami, is awarding a number of contracts for completion of new one-story plant for the manufacture of paper boxes and containers, recently referred to in these columns, including plumbing, electrical, painting, etc. Work on structure is being placed under way, and is scheduled for completion in fall. It will be 80 x 255 feet, reported to cost approximately $65,000, with equipment. Erection is being carried out by M. R. Harrison Construction Corporation, 1605 Biscayne boulevard, Miami, general contractor. L. B. Taylor, Congress Building, Miami, is consulting engineer, in charge.

Philadelphia, Pa.—Container Corporation of America, Inc., Nixon and Fountain streets, manufacturer of corrugated paper boxes and containers, has let general contract to the Lauter Construction Company, 1613 Sansom street, for alterations and improvements in local mill, including interior modernization for increased operating facilities. No estimate of cost announced. Work is scheduled to begin soon.

New York, N. Y.—The Central Corrugated Container Corporation, recently organized with capital of $10,000, plans operation of a plant for the manufacture of a line of corrugated paper boxes and containers. New company is represented by Louis L. Greenberg, 261 Broadway, New York, attorney.

Detroit, Mich.—The Detroit Wax Paper Company, 1721 West Pleasant street, River Rouge, Detroit, manufacturer of waxed and other processed paper stocks, has work under way on new addition to plant, previously noted in these columns, for which erection contract has been let to the C. A. Handeyside Construction Company, General Motors Building. New unit will be one-story and will be used for expansion in mill. It is scheduled for completion in fall and is reported to cost approximately $60,000, with equipment.

Lewistown, Pa.—The American Viscose Corporation, Delaware Trust Building, Wilmington, Del., manufacturer of viscose rayon products, has approved plans for one-story addition to branch mill at Lewistown, to be equipped for expansion in dryer division. Bids have been asked on general erection contract and work will begin soon. Cost reported over $45,000, with equipment.

Chicago, Ill.—The Acme Paper Box Company, Inc., 2427 West 14th street, and Acme Carton Company, Inc., same address, affiliated organizations, have plans under way for new one-story addition to recently acquired one and two-story plant at State and Sixtieth streets, previously referred to in these columns, to occupy part of adjoining tract of land, purchased at same time. New structure will be used for storage and distributing service, and with proposed improvements in existing building, is estimated to cost about $50,000, with equipment. As previously noted, company will develop property for new plant, providing for large increase in present capacity. It is proposed to remove to new location around the end of this year. M. L. Bernstein is president.

New Companies

New York, N. Y.—The Douglas Paper Products, Inc., has been incorporated with capital of 200 shares of stock, no par value, to deal in paper cups, paper boxes and containers, and allied products. New company is represented by Antman & Miller, 1450 Broadway, New York, attorneys.

Milwaukee, Wis.—National Paper Can and Tube Company has been organized to deal in paper cans and containers, paper tubing, etc. Incorporators include H. J. Berenson, John C. Mahoney and Alan H. Steinmetz, 735 North Water street. Last noted is company representative.

Archbold, Ohio—American Cellulose, Inc., has been incorporated to manufacture cellulose products. It is proposed to operate a local mill. Incorporators include Owen Rice, John E. Palmer and Lloyd L. Urich, Archbold.

New York, N. Y.—The Ardsley Paper Corporation has been incorporated with capital of 200 shares of stock, no par value, to deal in paper goods of various kinds. New company is represented by Philip S. Birnbaum, 358 Fifth avenue, New York, attorney.

Puget Sound to Vote on Expansion

San Francisco, Cal., August 27, 1940—The Puget Sound Pulp and Timber Company today called a special meeting of stockholders for September 9 to vote on construction of a new plant addition which would increase the company's capacity to produce unbleached sulphite pulp from 100,000 to 150,000 tons a year.

Cost of the addition is set at $1,500,000 which the company proposes to acquire on unsecured bank loan maturing 1941-1945 at interest of from 3 to 4½ per cent.

Officials estimate the plant would be in operation for 10 months next year and would earn net profit of $1,200,000 on capacity output in that time, all of which would be applied to the repayment of the loan.

QUALITY · EXPERIENCE · SERVICE

Write for information on our new complete line of wood cleaning equipment.

D. J. MURRAY MFG. CO.
WAUSAU, WISCONSIN

More FIBRE
FOR YOUR MONEY

PQ SILICATE aids the paper maker to get more water into the fibre. Quite noticeably PQ Silicates in the beater step up hydration. Therefore shorter beating time produces as much stock at a given hydration with 20-25% less cost for power.

Also, PQ Silicate improves the fibre retention and the short fibres are laid flat.

Know more about improved hydration and fibre retention by using the right grade of silicate *properly.* May we discuss the application in your mill?

SILICATES OF SODA

PHILADELPHIA QUARTZ CO.

General Offices & Laboratory: 125 S. Third St., Phila., Pa.
Chicago Sales Office: 205 W. Wacker Drive. Stocks in 60 cities.
Sold in Canada by NATIONAL SILICATES LTD., Toronto, Ont.

New York Paper and Pulp Market Review

Scarcity of Imported Unbleached Sulphite Pulp More Acute—Kraft Pulp Market Easier — Resale Paper Quotations A Little Higher On Some Grades—Several Grades of Paper Stock Lower.

Office of the PAPER TRADE JOURNAL,
Wednesday, August 28, 1940.

Sales volume in the wholesale paper market continues to reflect the seasonal lull which is a more or less normal state of trade at this date. In general, wholesale trade is undergoing a mild adjustment and this condition is also applicable to the paper industry and trade. This is a natural condition due to production expanding more rapidly than sales by about 12 per cent and this difference is now being adjusted as sales are reported expanding satisfactorily, while production in many lines is moving less rapidly. The expansion of industry and trade in July reached the high point of the year and averaged 11 per cent higher in the first half of 1940 than for the first half of 1939. Mill orders for paper and pulp were reported to be the highest since 1931.

The index of general business activity rose to 103.5 per cent for the week ended August 17, from 101.9 per cent for the preceding week, compared with 91.5 per cent for the corresponding week last year.

Paper production of 222 mills for the week ended August 17 was estimated at 87.3 per cent, compared with 81.9 per cent for 1939, with 78.0 per cent for 1938, with 83.7 per cent for 1937, and with 80.2 per cent for the corresponding week for 1936.

Paper board production for the week ended August 17 was 73.0 per cent, compared with 72.0 per cent for 1939, with 67.0 per cent for 1938, with 73.0 per cent for 1937, and with 75.0 per cent for the corresponding week for 1936.

The trend of paper prices, which has been upward for some weeks has at length brought about a moderate advance in some grades of paper. For example, No. 4 sulphite bond is now quoted at from 7.70 to 9.50, No. 1 antique book at from 9.05 to 10.05, and the A grade of E. F. is currently quoted for resale at from 8.20 to 9.50. The four standard grades of glossy coated papers remain unchanged.

Mechanical Pulp

Production and consumption of mechanical pulp continues at a good level, with no important change in the market situation reported this week. Prices are unchanged.

Chemical Pulp

Good grades of imported unbleached sulphite pulp are very firm. With very little tonnage in this particular grade available, the situation in imported unbleached sulphite is acute and spot prices are higher. One of the best brands of Swedish unbleached sulphite was recently offered at $86 per ton on dock, but no sale was reported on the small lot. Pulp stocks on dock at this date are estimated at not more than 150,000 tons for all kinds of pulp.

Kraft pulp prices are a little easier this week, with buyers not disposed to pay the high spot prices asked a short time ago. Contract prices on all grades of pulp are unchanged.

Rags

Mill buying is reported limited to a few grades of high quality rags. Prices are firm and no changes from prevailing market quotations have been reported this week on any grade of rags.

Old Rope and Bagging

Prices hold firm on all grades of old rope, with a fair demand reported for mixed strings. No change in prices has been reported at this date.

Trading in old bagging continues limited with prices continuing unchanged on domestic and foreign gunny.

Old Waste Paper

The old waste paper market is a little softer this week, with lower prices on several grades. White ledger stock is down to 1.80 to 1.90 and colored ledger stock is currently quoted at from 1.30 to 1.40. Old kraft is down to 1.50 to 1.60; strictly folded news, to .32½ to .35; corrugated, .50 to .55, and No. 1 mixed paper is currently quoted at from .22½ to .24.

Twine

Twine prices are fairly firm at this date, with demand reported satisfactory for the season. Uncertainty as to supplies of imported fibers continues to create concern in the trade, and merchants continue to reserve the privilege of limiting quantities on foreign fiber twines to customers.

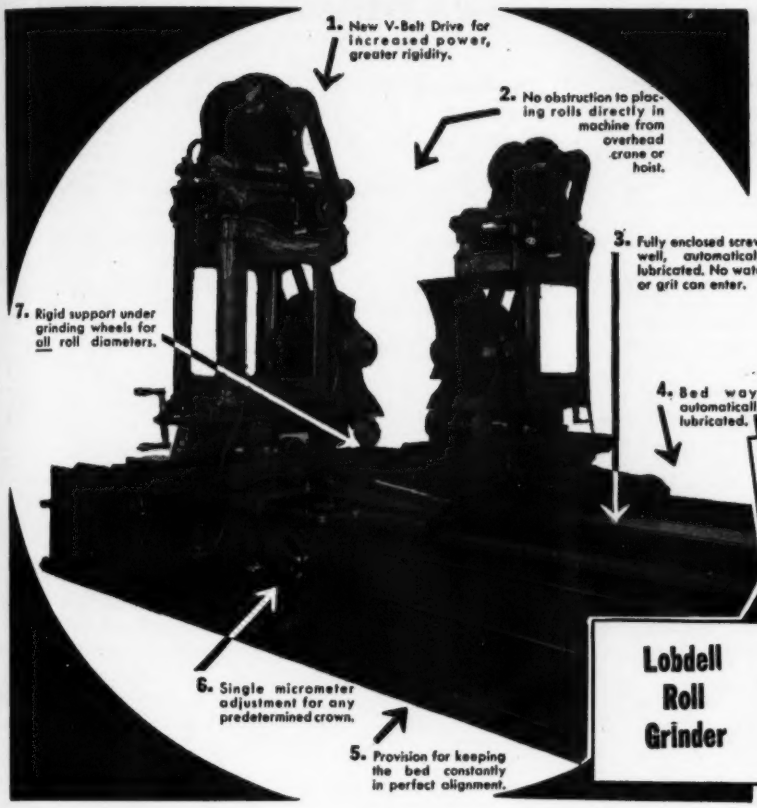
Geo. W. Millar & Co. Buy Building

George W. Millar & Co., Inc., paper and paper mill supplies dealers, have purchased the building at 284-290 Lafayette Street, New York, which they have occupied for the last 18 years. The structure is of brick, six stories and extends through from Lafayette Street to 121-127 Crosby Street. The property is assessed on the tax books for $100,000.

The Soft Ball team have just completed their season finishing in third place in the Paper Trade League. After the last game had been played the members of the team and the ladies of the staff were given a dinner by the firm at the Village Barn, New York City at which Vice President John J. Dillon presided. A very enjoyable evening was had by all, especially interesting were the games participated in. Miss Mildred Dunne won first prize in the Country Square Dance by her agility in swinging partners. Henry Krudop and Isabella Ceva took first honors in the potato race and Lillian Kearney won the Going to Jerusalem event.

Folding Box Shipments Lower

The Folding Paper Box Manufacturers Association, Inc., announces that shipments of folding boxes into the metropolitan New York area for July totaled $667,948. This figure compares with $720,372 for June and $530,612 for July, 1939.


1. New V-Belt Drive for increased power, greater rigidity.
2. No obstruction to placing rolls directly in machine from overhead crane or hoist.
3. Fully enclosed screw-well, automatically lubricated. No water or grit can enter.
4. Bed ways automatically lubricated.
5. Provision for keeping the bed constantly in perfect alignment.
6. Single micrometer adjustment for any predetermined crown.
7. Rigid support under grinding wheels for all roll diameters.
Lobdell Roll Grinder

Study these seven points of advantage . . . They're the features you've wished you had on roll grinders you're using now.

7 IMPORTANT ADVANTAGES ★

SAVES TIME! SAVES MONEY!

OVER 70 DIFFERENT PAPER MILLS USE IT!

Mill men have called this Lobdell Grinder "the last word" in such machines. Judge it for yourself; write for detailed information.

LOBDELL CAR WHEEL COMPANY
WILMINGTON • DELAWARE

More than 1450

TRIMBEY REGULATORS

CONSISTENCY AND WEIGHT

now in use!

PUMP TYPE
As "sampling" or "pump type" regulators controlling up to 400 tons per day to metering systems.

•

On pulp as slow as glassine: as free as unbeaten kraft.

BRUSHING ACTION
For controlling consistency to Jordans for uniform brushing action.

•

On all grades from finest rag writings to box board.

MIXING BOX
As "Mixing Box Type" regulators on machines making from 100 tons to as little as 2 tons a day.

TRIMBEY MACHINE WORKS
GLENS FALLS, N. Y.

MISCELLANEOUS MARKETS

Office of the PAPER TRADE JOURNAL,
Wednesday, August 28, 1940.

BLANC FIXE—Quotations on blanc fixe are firm and continue unchanged at prevailing market levels. Demand reported fair for the week. The pulp is currently quoted at $35 per ton, in barrels, at works; the powder is offered at $50 per ton, f.o.b., works.

BLEACHING POWDER—Prices on bleaching powder are firm, with demand continuing steady at this date. Bleaching powder is currently quoted at $2 per 100 pounds, in drums, at works.

CASEIN—Quotations on casein are reported unchanged for this week. Standard domestic casein, 20-30 mesh, is currently quoted at from 13½ to 14½ cents per pound; 80-100 mesh, at from 14 to 15 cents per pound; all prices in bags, car lots. Standard Argentina casein is currently offered at from 11½ to 12½ cents per pound. Quotations on French casein are nominal.

CAUSTIC SODA—Prices on caustic soda are firm and unchanged. Demand reported continuing moderately active. Solid caustic soda is currently quoted at $2.30 per 100 pounds; flake and ground at $2.70 per 100 pounds, in drums, at works.

CHINA CLAY—Quotations on china clay are firm and continue unchanged this week. Domestic filler clay is currently quoted at from $7 to $15 per ton; coating clay at from $11 to $22 per ton, at mines. Imported clay is quoted at from $13 to $25 per long ton, ship side.

CHLORINE—The demand for chlorine is reported as good, with prices firm and unchanged for the week. Chlorine is currently quoted at $1.75 per 100 pounds, in single-unit tank cars, f.o.b., works.

ROSIN—The rosin market is reported as firm with prices a little higher for the week, "G" gum rosin is currently quoted at $1.79 per 100 pounds, in barrels, Savannah. "FF" wood rosin is currently quoted at $1.70 per 100 pounds, in barrels, New York.

SALT CAKE—Prices on salt cake are firm under a good demand with current quotations continuing nominal. Domestic salt cake is currently quoted at $17 per ton in bulk; chrome sale cake at $16 per ton. All prices in car lots, f.o.b. shopping point. The quotation of $20 per ton on imported salt cake continues nominal.

SODA ASH—Quotations on soda ash are firm and continue to conform to prevailing market quotations. Shipments reported moderately active. Quotations on soda ash in car lots, per 100 pounds, are as follow: in bulk, $.90; in paper bags, $1.05; and in barrels, $1.35.

STARCH—Prices on corn starch are fairly firm and continue unchanged at prevailing market quotations. Pearl is currently quoted at $2.90 per 100 pounds; powdered starch at $3 per 100 pounds; all prices in bags, car lots, f.o.b., Chicago.

SULPHATE OF ALUMINA—Quotations on sulphate of alumina are firm. Demand moderately active for this week. The commercial grades are currently quoted at $1.15 per 100 pounds; iron free at $1.45 per 100 pounds, in bags, car lots, f.o.b., works.

SULPHUR—Prices on sulphur are firm and continue to conform to prevailing market quotations. Annual contracts are currently quoted at $16 per long ton, f.o.b., mines. Spot and nearby car lots are quoted at $19 per ton.

TALC—Quotations on talc are firm and continue unchanged at prevailing market prices. Domestic talc is currently quoted at from $15 to $18 per ton, Eastern mines. Imported talc is offered at from $23 to $45 per ton.

MARKET QUOTATIONS

Paper

(Delivered New York)

News, per ton—			
Roll, contract	$50.00	@	—
Sheets	58.00	"	—
Kraft—per cwt.—Delivered Zone A			
Northern, Extra Quality	$5.25	@	$5.75
Superstandard	4.87½	"	5.25
Northern Standard Wrapping	4.37½	"	4.62½
Standard Wrapping	4.25	"	—
Tissues—Per Ream—Carlots			
White No. 1	.97½	"	—
White No. 1 M. G.	.95	"	—
White No. 1½	.80	"	—
White No. 2	.75	"	—
Anti-Tarnish M. G.	.85	"	—
Colored	.85	"	—
Kraft	.87½	"	—
Manila	.77½	"	—
Unbl. Toilet, 1 M.	3.75	"	—
Bleached Toilet	5.26	"	—
Paper Towels, Per Case—			
Unbleached, Jr.	2.10	"	—
Bleached, Jr.	3.60	"	—
Manila—per cwt.—C. l. l. a.			
No. 1 Jute	8.25	@	10.25
No. 1 Manila Wrapping, 35 lb.	5.25	"	—
No. 2 Manila Wrapping, 35 lb.	5.00	"	—
Boards, per ton—			
News	35.00	@	40.00
Chip	35.00	"	40.00
Sgl. Mla. Ll. Chip	55.00	"	57.00
White Pat. Coated	67.00	"	70.00
Kraft Liners	55.00	"	—
Binders Boards	73.00	"	80.00

The following are representative of distributors' resale prices:

Rag Content Bonds and Ledgers—
White, Assorted Items,
Delivered in Zone 1:

	Bonds		Ledgers	
100% Rag Ext. No. 1	$39.10	@ $46.00	$40.25	@ $47.25
100% Rag	31.05 "	36.50	32.20 "	37.75
85% Rag	.... "	....	29.90 "	35.00
75% Rag	23.60 "	27.75	24.75 "	29.00
65% Rag	.... "	....	21.65 "	26.25
50% Rag	17.55 "	21.50	18.70 "	22.75
25% Rag	14.65 "	17.75	15.80 "	19.25

Colors at $1.00 cwt. extra.

Sulphite Bonds and Ledgers—
White, Assorted Items,
Delivered in Zone 1:

	Bonds		Ledgers	
No. 1	$9.35	@ $11.50	$11.55	@ $12.75
No. 2	8.50 "	10.25	9.65 "	11.75
No. 3	8.05 "	9.25	9.20 "	11.25
No. 4	7.70 "	9.50	8.90 "	10.75

Colors $1.00 cwt. extra.

Free Sheet Book Papers—
White, Cased Paper,

Delivered in Zone 1:

No. 1 Glossy Coated	$11.90	@	$13.50
No. 2 Glossy Coated	10.35	"	11.75
No. 3 Glossy Coated	9.55	"	11.00
No. 4 Glossy Coated	9.15	"	10.50
No. 1 Antique (watermarked)	9.05	"	$10.50
No. 2 Offset	8.40	"	9.75
A Grade E. F.	8.20	"	9.50
A Grade S. & S. C.	8.45	"	9.75
B Grade E. F.	7.65	"	8.75
B Grade S. & S. C.	7.90	"	9.00
C Grade E. F.	7.35	"	8.50
C Grade S. & S. C.	7.60	"	8.75
D Grade E. F.	7.10	"	8.25
D Grade S. & S. C.	7.35	"	8.50

Ivory & India at $.50 cwt. extra.

Mechanical Pulp

(On Dock, Atlantic Ports)

No. 1 Imported—			
Moist	Nominal		
Dry	Nominal		
(Delivered)			
No. 1 Domestic and Canadian	45.00	@	46.00

Chemical Pulp

(On Dock, Atlantic, Gulf and West Coast Ports)

Bleached Sulphite (Domestic and Foreign)—			
Prime Bleached Sulphite	3.72½	@	4.00
Prime Qualities—			
Easy-Bleaching Sulphite	3.17½	"	3.75
Strong Unbleached Sulphite	3.17½	"	3.75
(On Dock, Atlantic Ports)			
Kraft Bleached	4.12½	"	4.00
Kraft Light & Strong	3.50	"	3.75
Kraft No. 1	3.40	"	3.60
(F. o. b. Pulp Mill)			
Kraft Domestic and Canadian	3.00	"	3.25
(Delivered)			
Soda Bleached	3.30	"	—

Add 60 cents per short ton, dock charges for Albany; $2.50 for Lake Ports East and $3.50 for Lake Ports West of Mackinac Straits.

Domestic Rags

New Rags

(Prices to Mill f. o. b. N. Y.)

Shirt Cuttings—			
New White, No. 1	6.75	@	7.00
Silesias No. 1	4.60	"	4.75
New Unbleached	6.50	"	6.75
Blue Overall	4.35	"	4.50
Fancy	3.25	"	3.50
Washables	2.00	"	2.15
Mixed Khaki Cuttings	2.75	"	3.00
O. D. Khaki Cuttings	3.15	"	3.35

Old Rags

White, No. 1—			
Repacked	3.25	"	3.50
Miscellaneous	2.75	"	3.00
White, No. 2—			
Repacked	2.50	"	2.75
Miscellaneous	2.00	"	2.25
Thirds and Blues—			
Repacked	2.00	"	2.25
Miscellaneous	1.75	"	1.90
Roofing Rags—			
No. 1	.95	"	1.00
No. 2	.80	"	.85
No. 3 (bagging)	.90	"	1.00
No. 4	.60	"	.65
No. 5A	.60	"	.65

Foreign Rags

All prices nominal

New Rags

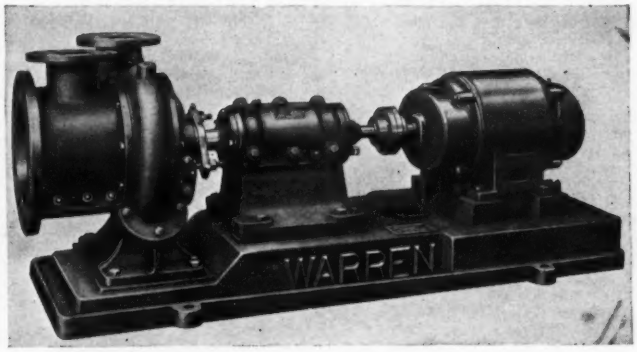
New Dark Cuttings	2.25	@	2.40
New Mixed Cuttings	2.00	"	2.20
New Light Silesias	5.50	"	5.75
Light Flannelettes	5.50	"	5.75
New White Cuttings	7.00	"	7.50
New Light Oxford	4.00	"	4.50
New Light Prints	3.00	"	3.25

Old Rags

No. 1 White Linens	7.50	"	8.50
No. 2 White Linens	6.50	"	7.50
No. 3 White Linens	4.50	"	—

4 Ounce Tolerance on 9 Pound All Rag Stock...

met successfully with a Warren Centrifugal Machine Chest Pump



That's a record. From a full to empty chest, a variation of 12 feet, the output of this Warren pump* was so steady that required tolerance was easily and consistently met. And the sheet was more uniform than obtained with the plunger pump previously used. Records like this are not exceptional. All Warren machine chest pump installations have been notably successful.

* Installation in a large eastern mill. Full details and list of other installations on request.

WARREN PUMPS

WARREN STEAM PUMP CO., INC., WARREN, MASSACHUSETTS

FARREL *Aids to Fine Paper Making*

FARREL ROLL CALIPERS—Reveal exact condition of your rolls; show slightest variation in diameter; measure exact amount of crown; move freely on rollers; easy to handle. Made in five sizes to measure rolls from 4″ to 50″ diameter.

FARREL ROLLS—The smooth finish, accurate bodies and journals and the correct crown shape of Farrel Rolls, the uniform hardness and depth of their chilled body surfaces, are prerequisite to the manufacture of top-quality paper. These qualities have distinguished Farrel Rolls for over eighty years and have made them the choice of paper makers who insist on quality output, dependable, economical service and minimum maintenance.

Farrel Rolls are made in chilled iron or extra hard "Farreloy", in any diameter from 4″ to 72″, any face length up to 312″.

FARREL ROLL GRINDERS— Specially designed for grinding long paper mill rolls, the Farrel Two-Wheel Swing-Rest Roll Grinder excels in producing rolls of close and uniform accuracy, with an exceptionally smooth finish that helps in making high-grade paper.

Dependence on the operator for results is minimized by many exclusive features. Heavy, durable construction, expert engineering and quality materials keep maintenance and depreciation low.

FARREL CALENDER STACKS—Designed and built for precision, durability and operating convenience. They are made in any size up to 312″ long on the face, equipped with chilled iron or "Farreloy" rolls, automatic lubrication, floor-operated lift and other modern features.

FARREL-BIRMINGHAM COMPANY, INC.

50 State St., Ansonia, Conn.

No. 4 White Linens	2.25	@	3.25
No. 1 White Cotton	4.25	"	4.75
No. 2 White Cotton	3.25	"	3.75
No. 3 White Cotton	2.50	"	3.00
No. 4 White Cotton	1.90	"	2.20
Extra Light Prints	2.00	"	2.40
Ord. Light Prints	1.75	"	2.15
Med. Light Prints	1.55	"	1.95
Dutch Blue Cottons	2.25	"	2.50
French Blue Linens	3.00	"	—
Checks and Blues	2.00	"	—
Linsey Garments	1.90	"	2.00
Dark Cottons	1.50	"	1.90
Old Shopperies	1.30	"	1.45
New Shopperies	1.45	"	1.50
French Blues	2.25	"	2.50

Old Rope and Bagging

(Prices to Mill, f. o. b. N. Y.)

Gunny No. 1—			
Foreign	2.75	@	3.00
Domestic	2.50	"	2.75
Wool Tares, light	2.00	"	2.25
Wool Tares, heavy	2.12½	"	2.25
Bright Bagging	2.25	"	2.50
Manila Rope—			
Foreign	4.75	"	5.00
Domestic	4.50	"	4.75
Jute Threads	2.62½	"	2.75
Sisal Strings	2.10	"	2.35
Mixed Strings	1.10	"	1.20

Old Waste Papers

(F. o. b. New York)

Shavings—			
White Envelope Cuttings	3.10	@	3.25
Ordinary Hard White No. 1	2.25	@	2.50
Soft White No. 1	1.80	"	1.90
Soft White Extra	2.50	"	2.60
Flat Stock—			
Stitchless	1.10	"	1.25
Overissue Mag	.90	"	1.00
Solid Flat Book	.80	"	.85
Crumbled No. 1	.70	"	.75
Ledger White Stock	1.80	"	1.90
Ledger Stock Colored	1.30	"	1.40
Manila—			
New Env. Cut	1.70	"	1.80
New Cuttings	1.30	"	1.40
Old Kraft Machine Compressed bales	1.50	"	1.60
News—			
No. 1 White News	1.75	"	1.90
Strictly Overissue	.70	"	.75
Strictly Folded	.32½	"	.35
Corrugated	.50	"	.55
No. 1 Mixed Paper	.22½	"	.25

Twines

(F. o. b. Mill)

(Soft Fiber)

Coarse Polished—			
India	.19½	@	—
White Hemp	.19¼	"	—
Fine Polished—			
Fine India	.23	"	—
Unpolished—			
Box	.17	"	—
Paper Makers	.15½	"	—
Tube Rope	.16¾	"	—
Wall Paper	.15½	"	—
Wrapping	.18	"	—
Soft Fiber Rope	.16¾	"	—
Cotton	.16¾	"	—

(Hard Fiber)

Medium Java	.20	"	—
Mex. Sisal	.17	"	—
Manila	.24	"	—

PHILADELPHIA

Domestic Rags (New)

(Price to Mill, f.o.b. Phila.)

Shirt Cuttings—			
New White No. 1	.06	@	.06¼
New White No. 2	.03½	"	.04
Light Silesias	—	"	.04½
Silesias, No. 1	—	"	.04
Black Silesias, soft	—	"	.02¼
New Unbleached	.06	"	.06¼
Washable Prints	.02¼	"	.02½
Washable, No. 1	—	"	.01¼
Blue Overall	.03¾	"	.04
Cottons—According to grades—			
Washable shredding	—	"	.01
Fancy Percales	—	"	.03
New Black Soft	—	"	.02¼
New Light Seconds	—	"	.04
New Dark Seconds	—	"	1.50
Khaki Cuttings—			
No. 1 O. D.	.03½	"	.03¾
No. 2 Mixed	.01¾	"	.02
Corduroy	.01¼	"	.01½
New Canvas	.04½	"	.05
New Black Mixed	—	"	.02¼

Domestic Rags (Old)

White No. 1—			
Repacked	3.00	@	3.50
Miscellaneous	2.50	"	2.75
Thirds and Blues—			
Miscellaneous	1.35	"	1.50
Repacked	1.55	"	1.65
Black Stockings (Export)	3.50	"	4.00
Roofing Stock—			
Foreign No. 1	Nominal		
Domestic No. 1	.92½	"	.95
Domestic No. 2	—	"	.80
Roofing Bagging	—	"	.70

Bagging

(f.o.b. Phila.)

Gunny, No. 1—			
Foreign	Nominal		
Domestic	2.25	@	2.75
Manila Rope	—	"	4.50
Sisal Rope	1.75	"	2.00
Mixed Rope	.75	"	1.00
Scrap—			
No. 1	2.50	"	2.75
No. 2	1.10	"	1.15
Wool Tares, heavy	3.50	"	3.70
No. 1 New Light Burlap	3.00	"	3.50
New Burlap Cuttings	2.00	"	2.25

Old Papers

(f.o.b Phila.)

Shavings—			
No. 1 Hard White	2.50	@	2.55
No. 2 Hard White	2.10	"	2.15
No. 1 Soft White	2.00	"	2.10
No. 2 Soft White	1.60	"	1.75
No. 1 Mixed	.90	"	1.00
Solid Ledger Stock	1.90	"	2.00
Ledger Stock, white	1.75	"	1.80
Ledger Stock, colored	1.25	"	1.30
No. 1 Books, heavy	.85	"	.90
Manila Cuttings	1.75	"	1.80
Print Manila	.60	"	.65
Container Manila	.50	"	.55
Kraft Paper	1.50	"	1.60
No. 1 Mixed Paper	.40	"	.45
Straw Board Chip	.40	"	.45
Binders Board Chip	.40	"	.45
Corrugated Board	.70	"	.75
Overissue News	.75	"	.80
Old Newspapers	.50	"	.55

BOSTON

Old Papers

(f.o.b. Boston)

Shavings—			
No. 1 Hard White	2.75	@	3.00
No. 1 Soft White	2.00	"	2.25
No. 2 Mixed	.75	"	.80
Solid Ledger Books	1.50	"	1.75
Overissue Ledger Stock	1.75	"	2.00
Mixed Ledgers	.85	"	.90
No. 1 Heavy Books	1.10	"	1.20
No. 1 Books, light	.65	"	.75
Crumpled Stitchless Book Stock	.55	"	.65
Manila Env. Cuttings	1.85	"	2.00
Manila Envelope Cuttings, extra quality	2.35	"	2.60
White Blank News	1.40	@	1.50
No. 1 Kraft	1.45	"	1.50
Extra No. 1 Kraft	1.60	"	1.90
Mixed Papers	.40	"	.45
Print Manila	.50	"	.55
Container Manila	.60	"	.70
Old Newspapers	.50	"	.55
Paper Wool Strings	.95	"	1.10
Overissue News	1.00	"	1.10
Box Board Chips	.40	"	.45
Corrugated Boxes	—	"	.55
Kraft corrugated boxes	1.20	"	1.25
New Kraft Corrugated Cuttings	1.87½	"	1.90
Screening Wrappers	.60	"	.70

Bagging

(f.o.b.Boston)

Gunny Bagging—			
Foreign	2.75	@	—
Domestic	2.25	"	2.50
Sisal Rope	2.25	"	2.50
Mixed Rope	.85	"	1.00
Transmission Rope—			
Foreign	—	"	2.40
Domestic	2.25	"	2.40
Soft Jute Rope	3.00	"	3.25
Manila Rope—			
Foreign	4.75	"	5.00
Domestic	4.75	"	5.00
Jute Carpet Threads	1.50	"	1.75
Gunny Bagging—			
Foreign	2.75	"	2.85
Domestic	2.25	"	2.50
Bleachery Burlap	4.00	"	3.25
Scrap Burlap—			
Foreign	2.40	"	2.50
Domestic	2.50	"	—
Scrap Sisal	2.25	"	2.50
Scrap Sisal for Shredding	2.30	"	2.65
Wool Tares, Heavy	2.40	"	2.50
New Burlap Cuttings	3.75	"	4.00
Aust. Wool Pouches	3.00	"	3.15
Heavy baling bagging	2.25	"	2.40
Paper Mill Bagging	1.75	"	2.00
No. 2 Bagging	.75	"	.80

Domestic Rags (New)

(F. o. b. Boston)

Shirt Cuttings—			
New Light Prints	—	@	.03
Fancy Percales	.04	"	.04¼
New White No. 1	.07½	"	.07¾
New Light Flannelettes	.05	"	.05¼
Canton Flannel, Bleached	.07	"	—
Silesias No. 1	.05	"	—
New Black Silesias	3.00	"	3.25
Red Cotton Cuttings	.04	"	.05
Soft Unbleached	.07	"	.07½
Blue Cheviots	.05	"	.05½
Fancy	.02	"	.02½
Washable	.02	"	.02¾
Cottons—According to Grades—			
Blue Overalls	.04¾	"	.05
New Black, Soft	.03	"	.03¼
Khaki Cuttings	.03	"	—
O. D. Khaki	.03	"	.03¼
Corduroy	.02¾	"	.03
New Canvas	.06¾	"	.07¼
B. V. D. Cuttings	.07	"	.07½

Domestic Rags (Old)

(F. o.b. Boston)

White No. 1—			
Repacked	2.75	"	3.75
Miscellaneous	2.40	"	2.60
White No. 2—			
Repacked	1.90	"	2.00
Miscellaneous	2.00	"	2.25
Twos and Blues	1.50	"	2.00
Old Blue Overalls	1.60	"	2.00
Thirds and Blues—			
Repacked	—	"	1.25
Miscellaneous	—	"	1.00
Black Stockings	3.50	"	4.00
Roofing Stock—			
No. 1	1.00	"	1.35
No. 2	—	"	1.10
No. 3	—	"	.90

Foreign Rags

(F. o. b. Boston)

Canvas	.04¼	@	—
Dark Cottons	(nominal)		
Dutch Blues	(nominal)		
New Checks and Blues	(nominal)		
Old Fustians	(nominal)		
Old Linsey Garments	(nominal)		
New Silesias	(nominal)		

CHICAGO

Waste Paper

(f.o.b. Chicago)

Shavings—			
No. 1 White Envelope cuttings	3.15	@	—
No. 1 Hard White	2.50	"	2.65
No. 1 Soft White	2.00	"	2.20
Ledger and Writings	.85	"	.95
Solid Books	.95	"	1.10
Blanks	1.50	"	1.60
Krafts	1.40	"	1.50
New Kraft Cuts	1.60	"	1.75
Overissue News	1.00	"	1.10
Old Newspapers—			
No. 1 Folded News	.70	"	.80
No. 1 Mixed Paper	.40	"	.50
Roofing Stocks—			
No. 1	.95	@	1.00
No. 2	.85	"	.90

To Aid Chemical Pulp Manufacture

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., August 19, 1940—At the request of the Sociedad Nacional Industrias Oplicaciones Celulosa Espanola the Spanish government has published a decree establishing the manufacture of chemical pulp as an industry of "national interest", according to the American Commercial Attache at Madrid. As a consequence the new industry will enjoy certain advantages outlined in a new law, namely, it will have the right to expropriate forest lands which may be necessary for the provision of wood for its manufacturing process, and it also will be granted a reduction of 50 per cent in all taxes for 15 years.

These privileges apply only to the manufacture of chemical pulp. The Spanish government has undertaken to make available sufficient foreign exchange for the import of necessary machinery as well as the payment of any patent royalties which may be involved. In the event of the Spanish company having a foreign organization as an associate, facilities will be granted for the payment each year of an amount equal to not more than 7 per cent as interest in the capital or rights supplied by the foreign associates. The concession has been granted with the understanding that its plant will be in strict keeping with the plans submitted to the Spanish government; that all imports of machinery or equipment are to be under the supervision of the Director General of Industry as well as the Director General of Customs, so that such imports can be verified and identified; and that materials, machinery, and equipment imported are only intended for the projected new industry and for its operation, and under no circumstances for any other enterprise.